



# Cr(VI)-free corrosion protection systems for components for commercial vehicle engineering

## MAN 183-3

Dimensions in mm

This English version is a translation. In case of doubt or conflict the valid German-language original will govern.

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**The MAN 183-3 standard shall be applied for the following applications:**

- Higher-strength fasteners (screws, bolts and nuts) of property class  $\geq 8.8/8$
- Fasteners (screws, bolts and nuts) of property class  $\leq 6.8/6$
- Fasteners with increased temperature requirements
- Wheel bolts and nuts
- Screws for thermoplastics
- Self-tapping screws
- Wood screws
- Thread rolling and thread cutting screws
- Pipe/hose fittings, hose mounts, and hose ferrules
- Washers
- General components
- Wheel bolts and nuts

**MAN 183-2 continues to apply to the following application:**

**Higher-strength fasteners (screws, bolts and nuts of property class  $\geq 8.8/8$ ) with surface protection containing Cr(VI) [blocked for new designs]**

Co-sponsors: EPTA

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Technical responsibility:

Kluger, EZGS

Standardization:

Jürgens, EZGS

Replaces:

MAN 183-3 : 2021-01

## 1 Scope and purpose

**The Cr(VI)-free corrosion protection systems as per this standard replace the previous systems containing Cr(VI) as per MAN 183-2 and DIN EN ISO 4042.**

If a Cr(VI)-free corrosion protection system in accordance with this norm is documented for a component, **in agreement with MAN** a corrosion protection containing Cr(VI) of the same type as per MAN 183-2 can be supplied for a certain transition period (except for pipe fittings).

If the supplier-specific approval for the Cr(VI)-free systems in accordance with Section 2 is not yet available, the coatings shall be reported to MAN as per Section 5 before use and shall be approved by MAN.

If there is already a supplier-specific approval as per Section 2 for a Cr(VI)-free corrosion protection system and **if MAN agrees**, the Cr(VI)-free system as per this standard can be delivered even if systems containing Cr(VI) (e.g. A3C) are specified in the standard designations in the master data or drawings. In such cases, MAN shall agree to a test exemption. This only applies to the applications approved as per this standard.

This standard describes Cr(VI)-free corrosion protection systems for various applications on iron materials and steel parts. The specific application characteristics are combined in corresponding requirement profiles by a code.

By stipulating additional requirements over and beyond generic standards, the purpose of this standard is to ensure the following for high-strength mechanical fasteners:

- the quality of the corrosion protection systems,
- resistance to hydrogen-induced brittle fracture and
- reduction in friction values and their distribution

## 2 Release conditions

All parts of the standard series MAN 239 apply. In these standards the release conditions and procedures as well as the general terms of delivery for purchased parts are laid down.

High-strength components with corrosion protection systems and lubricants in accordance with this standard shall be purchased only from manufacturers/coating companies that have been approved by MAN.

Release of the coating system by MAN is required for components with defined assembly characteristics. The Standardization department (EZGS) shall be contacted for this release.

In the case of the initial release of corrosion protection systems/coating companies for electroplated coatings for parts with strengths of  $R_m \geq 1000 \text{ N/mm}^2$  and for other systems for parts with strengths of  $R_m \geq 1200 \text{ N/mm}^2$ , proof shall be produced of measures to protect against hydrogen-induced brittle fracture as per DIN 50969-1 /-2 and, if requested by MAN, of a bracing test carried out as per Section 6.9.

The corrosion protection properties of the systems in accordance with Section 6.10 are verified with approval of the corrosion protections systems and coating companies by the Materials Technology department. Corrosion-related approval of these systems is documented via the system/material item numbers (also see Appendix A) in host screen T127A. Verification of other functional characteristics (e.g. friction coefficients, electrical conductivity, etc.) is not part of this corrosion-related approval inspection.

For this purpose, the corrosion protection system shall be presented in good time for material approval to the Materials Technology department in the form of coated series components, **including a report as confirmation of compliance with the requirements in accordance with Section 6.10 issued by an accredited test laboratory (DIN EN ISO / IEC 17025)**. In addition to the test report relating to the respective requirements, a detailed description of the corrosion protection system shall also be submitted.

Process control and the process technologies used for the coating process (pretreatment, coating, heat treatment and post-treatment processes) shall be checked and evaluated as part of the initial sample release.

The released corrosion protection system/coating company shall be used for all series deliveries and shall only be changed with the agreement of MAN and after a new initial sample inspection.

Any change to the corrosion protection system and processes will necessitate a new release by MAN.

### 3 Designation of the corrosion protection systems

#### 3.1 Designation of the corrosion protection systems of MAN

- In technical documentation (drawings): e.g. **Corrosion protection MAN 183-B1**  
or **MAN 183-PHR**
  - In the designation of standard parts: e.g. **Hex bolt DIN 931-M10x40-10.9-MAN 183-B1**  
**Self-tapping screw 3296 ST4,2x22-MAN 183- B4 - OS-SW**  
**MAN 183- B1** **-finish-rolled**
- Number of this standard \_\_\_\_\_
- Code for the corrosion protection system in accordance with Table 1a \_\_\_\_\_
- Without lubrication, see Section 6.6 \_\_\_\_\_
- There is no need to specify -OS in the standard designations in assembly drawings
- Finish rolling only in special cases in accordance with Section 6.11 \_\_\_\_\_

#### 3.2 Designation of the corrosion protection systems of MAN and Scania

New corrosion protection systems for fasteners will be defined as a result of the cooperation between MAN and Scania. It is planned to document these systems in CVS16.

- In technical documentation (drawings): e.g. **Corrosion protection MAN 183-X1**
  - In the designation of standard parts: e.g. **Hex bolt DIN EN 1665-M10x40-10.9-MAN 183-X1**
- Number of this standard \_\_\_\_\_
- Code for the corrosion protection system in accordance with Table 1b \_\_\_\_\_

### 4 Corrosion protection systems

Table 1 of this standard specifies the properties and requirements for standard type codes that can be met with different Cr(VI)-free corrosion protection systems. Thus, electroplated coatings can be used in parallel with zinc flake coatings for some type codes.

**Table 2 defines which Cr(VI)-free corrosion protection systems are released for particular application areas with specific application characteristics.**

**Explanation of the footnotes in Table 1a and 1b**

- <sup>0)</sup> The provisions in Sections 1 and 6 shall be observed for non-high-strength components with a strength of  $PC \leq 6.8 / 6$  or  $R_m \leq 600 \text{ N/mm}^2$
- <sup>1)</sup> For mechanical fasteners with property class  $\geq 8.8/8$  as per VDA 235-104.10.
- <sup>2)</sup> Only for strengths  $R_m \geq 1000 \text{ N/mm}^2/PC 10.9$ .
- <sup>3)</sup> With or without lubrication as per Table 2 and -OS specification.
- <sup>4)</sup> The coating MAN183-B4 or MAN183-B16 is permitted only if the colour black is required for design reasons or as a distinguishing feature for pipe fittings.
- <sup>5)</sup> For coatings MAN183-B1 and MAN183-B4, suitable coating procedures are required, in particular for internal threads, small external threads, and internal drives with scooping areas.
- <sup>6)</sup> The coating of fasteners of property class 12/12.9 with electroplating systems is not permitted.
- <sup>7)</sup> Higher strengths shall be released separately.
- <sup>8)</sup> Since zinc-flake coating is not permitted for thread diameters of less than M6 for MAN183-B1 and MAN183-B4, thread diameters of  $\leq M5$  are coated with electroplated ZnNi with passivation and where appropriate sealing.
- <sup>9)</sup> See M 3536 Table 4 for definition of normal area and special area
- <sup>10)</sup> The tolerance position shall be taken into account if a red rust resistance of 720 h is required for higher-strength fasteners. The tolerance position of the uncoated component shall be specified in the initial sample report.
- <sup>11)</sup> See Table 4
- <sup>12)</sup> Binding for material releases as from May 2021
- <sup>13)</sup> Due to the irregular and not deep-black appearance, B4 is not recommended for design requirements

Table 1a MAN corrosion protection systems; type codes, properties, and requirements



| Code of the corrosion protection system  | MAN183-PHR <sup>1)</sup>                          | MAN183-B1 <sup>5)8)</sup>  | MAN183-B4 <sup>4)5)8)</sup><br><sup>13)</sup> | MAN183-B7                         | MAN183-B11   |
|--|---|--|---|-----------------------------------|--|
| Time until red rust occurs, test as per DIN EN ISO 9227-NSS                            | 6 h <sup>11)</sup>                                | 480 h<br>-----<br>720 h:<br>- higher-strength fasteners <sup>10)</sup><br>- screws for thermoplastics<br>- self-tapping screws                     | 480 h   | 120 h                             | 720 h (normal area)<br>480 h (special area)<br><sup>9)</sup> |
| Approved for tensile strengths R <sub>m</sub> in N/mm <sup>2</sup> or PC <sup>0)</sup> | --  | The following applies for electroplated coatings:<br>R <sub>m</sub> ≤ 1000 or PC ≤ 10.9/10   |   | --                                | R <sub>m</sub> ≤ 1000 <sup>7)</sup>                          |
| Type of system (without lubricant)<br>For lubricants, see Section 6.6                  | Phosphating, oiled <sup>1)</sup>                  | Coating system consisting of metal pigment layer or electroplated coating (+ passivation) as base layer and, if appropriate, sealing <sup>6)</sup> |   | Metal pigment layer with top coat | Electroplated ZnNi coating with thick-coat passivation       |
| Colour of system   | <b>Grey/black</b>                                 | <b>Silver-grey</b>   | <b>Black</b>                                  | <b>Grey</b>                       | <b>Silver-grey</b>   |
| Layer thicknesses <sup>12)</sup>   | max. 5 µm <sup>1)</sup><br>Otherwise<br>min. 5 µm | Min. 8 µm  |   |                                   |  |
| General requirements   | DIN EN ISO 9717                                   | Section 6.2, VDA 235-104, for pipe fittings VDMA 24576   |   | Section 6.2, VDA 235-104          | Section 6.2, VDA 235-104, for pipe fittings VDMA 24576       |
| Additional requirements:   | See Section:                                      | See Section:   |   | See Section:                      | See Section:   |
| - Component condition  | 6.1   | 6.1  |   | 6.1                               | 6.1  |
| - Preliminary treatment  | 6.3   | 6.3  |   | 6.3                               | 6.3  |
| - Corrosion protection system  | 6.4.1   | 6.4.2 or 6.4.3   |   | 6.4.3                             | 6.4.2  |
| - Heat treatment/annealing   | 6.5.1 <sup>2)</sup>                               | 6.5.1  |   | --                                | 6.5.2  |
| - Lubricant/friction values <sup>3)</sup>  | 6.6/6.7   | 6.6/6.7  |   | --                                | --   |
| - Coating thickness  | 6.8   | 6.8  |   | 6.8                               | 6.8  |
| - Bracing test   | 6.9   | 6.9  |   | 6.9                               | 6.9  |
| - Corrosion resistance   | 6.10  | 6.10   |   | 6.10                              | 6.10   |
| - Electrical conductivity  | Good  | None   |   | None                              | Good   |
| - Contact corrosion  | see M 3539  | see M 3539   |   | see M 3539                        | see M 3539   |
| - Finish rolling (special case)  | 6.11  | 6.11   | 6.11  | 6.11                              | --   |

**Table 1a MAN corrosion protection systems; type codes, properties, and requirements**



| Code for coating  | MAN183-B12   | MAN183-B13 <sup>6)</sup>                                      | MAN183-B15 <sup>6)</sup>  | MAN183-B16 <sup>4)6)</sup>  | MAN183-B31             | MAN183-B32             |
|---|--|---|---|---|------------------------|------------------------|
| Time until red rust occurs,<br>test as per<br>DIN EN ISO 9227-NSS                         | 720 h (normal area)<br>480 h (special area)<br><sup>9)</sup>                   | 120 h   | 240 h   | 240 h   | 720 h                  | 720 h                  |
| Approved for tensile strengths<br>R <sub>m</sub> in N/mm <sup>2</sup> or PC <sup>0)</sup> | R <sub>m</sub> ≤ 1000  | R <sub>m</sub> ≤ 1000 or<br>PC ≤ 10.9/10                      |   |   |                        |                        |
| Type of system<br>(without lubricant)<br>For lubricants, see Section 6.6                  | Electroplated<br>ZnNi coating<br>with thick-coat<br>passivation and<br>sealing | Electroplated<br>Zn coating<br>with thick-coat<br>passivation | Electroplated<br>ZnFe coating<br>with thick-coat<br>passivation | Electroplated<br>ZnFe coating with<br>thick-coat passivation<br>and sealing | Metal pigment<br>layer | Metal pigment<br>layer |
| Colour of system  | <b>Silver-grey</b>   | <b>Silver grey<br/>iridescent</b><br>(guide value)            | <b>Silver grey<br/>iridescent</b><br>(guide value)              | <b>Black</b>  | <b>Silver-grey</b>     | <b>Silver-grey</b>     |
| Layer thicknesses <sup>12)</sup>  | Min. 8 µm  | Min. 5 µm   | Min. 8 µm   |   |                        |                        |
| General requirements  | Section 6.2,<br>VDA 235-104,<br>for pipe fittings<br>VDMA 24576                | Section 6.2, VDA 235-104                                      |   |   |                        |                        |
| Additional requirements:  | See Section:   |   |   |   |                        |                        |
| - Component condition   | 6.1  | 6.1   | 6.1   | 6.1   | 6.1                    | 6.1                    |
| - Preliminary treatment   | 6.3  | 6.3   | 6.3   | 6.3   | 6.3                    | 6.3                    |
| - Corrosion protection system   | 6.4.2  | 6.4.2   | 6.4.2   | 6.4.2   | 6.4.3                  | 6.4.3                  |
| - Heat treatment/annealing  | 6.5.2  | 6.5   | 6.5   | 6.5   | 6.5                    | 6.5                    |
| - Lubricant/friction values <sup>3)</sup>   | --   | 6.6/6.7   | 6.6/6.7   | 6.6/6.7   | 6.6/6.7                | 6.6/6.7                |
| - Coating thickness   | 6.8  | 6.8   | 6.8   | 6.8   | 6.8                    | 6.8                    |
| - Bracing test  | 6.9  | 6.9   | 6.9   | 6.9   | 6.9                    | 6.9                    |
| - Corrosion resistance  | 6.10   | 6.10  | 6.10  | 6.10  | 6.10                   | 6.10                   |
| - Electrical conductivity   | None   | Good  | Good  | None  | None                   | None                   |
| - Contact corrosion   | see M 3539   | see M 3539  | see M 3539  | see M 3539  | see M 3539             | see M 3539             |
| - Finish rolling (special case)   | --   | 6.11  | 6.11  | 6.11  | 6.11                   | 6.11                   |

Table 1b MAN and Scania corrosion protection systems; type codes, properties, and requirements



| Code for coating   | MAN 183-X1                              |  |  |  |  |  |
|--|---|--|--|--|--|--|
| Time until red rust occurs,<br>test as per<br>DIN EN ISO 9227-NSS                | 720 h                                   |  |  |  |  |  |
| Approved for tensile strengths<br>$R_m$ in N/mm <sup>2</sup> or PC <sup>0)</sup> | $R_m \leq 1000$ or<br>PC $\leq 10.9/10$ |  |  |  |  |  |
| Type of system<br>(without lubricant)<br>For lubricants, see Section 6.6         | Metal pigment layer<br>with top coat    |  |  |  |  |  |
| Colour of system   | <b>Black</b>                            |  |  |  |  |  |
| Layer thicknesses <sup>12)</sup>   | Min. 8 $\mu$ m                          |  |  |  |  |  |
| General requirements   | Section 6.2,<br>VDA 235-104             |  |  |  |  |  |
| Additional requirements:   | See Section:                            |  |  |  |  |  |
| - Component condition  | 6.1                                     |  |  |  |  |  |
| - Preliminary treatment  | 6.3                                     |  |  |  |  |  |
| - Corrosion protection system  | 6.4.3                                   |  |  |  |  |  |
| - Heat treatment/annealing   | 6.5.1                                   |  |  |  |  |  |
| - Lubricant/friction values <sup>3)</sup>  | 6.6/6.7                                 |  |  |  |  |  |
| - Coating thickness  | 6.8                                     |  |  |  |  |  |
| - Bracing test   | 6.9                                     |  |  |  |  |  |
| - Corrosion resistance   | 6.10                                    |  |  |  |  |  |
| - Electrical conductivity  | None                                    |  |  |  |  |  |
| - Contact corrosion  | No data                                 |  |  |  |  |  |
| - Finish rolling (special case)  | 6.11                                    |  |  |  |  |  |

Table 2 - Applications

|    | Code  | Corrosion protection system              | Lubrication/subsequent treatment  | Released systems **)                       | Comments   |
|----|---|--|---|--|--|
| 1. | <b>Higher-strength fasteners (screws, bolts and nuts) of property class <math>\geq 8.8/8</math></b><br>The coating of fasteners with property class 12/12.9 with electroplating systems is not permitted. |  |   |  |  |
|    | MAN 183-B1  | Zinc-flake coating without top coat ***) | Normal case: With lubricant according to M 3222<br>Lubrication with Delta-Lube 10 green is omitted for micro-encapsulated screws                        | Delta Protekt KL 100 + Delta-Lube 10 green | The max. layer thickness shall not restrict screwability.<br>Only for thread diameters $\geq M6$   |
|    |   | Electroplated coating                    |   | ZnNi as per M 3536 Type SVR                | <b>Only for thread diameters &lt; M6</b>   |
|    | MAN 183-B4 *)   | Zinc-flake coating                       | Lubricant coating to achieve the friction coefficients in Section 6.7   | (Normal case) Delta Tone/Delta Seal        | Colour black due to design requirements<br>Fasteners in visible area in the interior.<br><b>Recommendation:</b><br>for use on exterior: MAN183-X1<br>Only for thread diameters $\geq M6$ |
|    |   | Electroplated coating                    |   | ZnNi as per M 3536 Type BVR                | <b>Only for thread diameters &lt; M6</b>   |
|    | MAN 183-PHR   | Phosphating                              | Subsequent treatment with silicone-free corrosion protection oils on all sides<br>Lubrication with lubricant oil emulsions (e.g. Parkerol) on all sides | Znph/r/5/T4                                | Application only inside units<br>The washing off of lubricant oil emulsions is not permitted.  |
|    | MAN 183-X1  | Zinc-flake coating                       | Lubrication integrated in top coat to achieve the friction coefficients in Section 6.7  | Delta Protekt KL120 + VH321 GZ             | Colour black also for design requirements<br>Fasteners in visible area<br>Only for thread diameters $\geq M6$  |

\*) Not to be used for fasteners with ribs (hexagonal flange nuts/ribbed bolts) since no assembly parameters have been defined up to the present time.

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

\*\*\*) In the case of prevailing torque type nuts with non-metallic insert, the plastic ring is crimped after the coating has been stoved in the case of zinc-flake coatings. This can result in impairment of the corrosion protection in the area of the plastic ring. A restriction in the corrosion protection can be accepted in this area.



Table 2 continued - Applications

|             | Code  | Corrosion protection system      | Lubrication/subsequent treatment                      | Released systems **)  | Comments   |
|-------------|---|----------------------------------|---|---|--|
| 2.          | Fasteners (screws, bolts and nuts) of property class ≤ 6.8/6 *) |                                  |   |   |  |
| Normal case | MAN 183-B1  | Electroplated coating            | Friction coefficients as per Section 6.7 do not apply | ZnNi as per M 3536 Type SV  | In the event of procurement problems for ZnNi in non-European locations, a zinc-flake coating can be procured in deviation from this.<br>The max. layer thickness shall not restrict screwability. |
|             | MAN 183-B4  | Zinc-flake coating with top coat |   | Delta Tone + Delta Seal Black (normal case)<br>(Geoblack) blocked for new designs | Colour black<br>for design requirements<br>Fasteners in visible area<br>Reduction of the risk of contact corrosion   |
|             |   |                                  |   | ZnNi as per M 3536 Type BV  |  |
|             | MAN 183-B11   | Electroplated coating            |   | ZnNi as per M 3536 Type S   | For conductive contact points which were previously coated with A2C/A3C  |
|             | MAN 183-B13   |                                  |   | Zn in accordance with DIN EN ISO 4042   | Use only in the interior and engine  |
|             | MAN 183-B15   |                                  |   | ZnFe in accordance with DIN EN ISO 4042   |  |
|             | MAN 183-B16   |                                  |   |   | Colour black<br>due to design requirements<br>Fasteners in visible area<br>Use only in the interior and engine   |
|             | MAN 183-PHR   | Phosphating                      |   | Subsequent treatment with silicone-free corrosion protection oils on all sides    | Znph/r/5/T4  |

\*) Components with lower-strength threads ( $\leq 600$  MPa) for which no property class in accordance with ISO 898 is specified and that cannot be assigned to Sections 3 to 9 are coated in accordance with Table 2.11 (e.g. plug screws)

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

Table 2 continued - Applications

|    | Code  | Corrosion protection system      | Lubrication/subsequent treatment                      | Released systems **)   | Comments  |
|----|---|----------------------------------|---|--|---|
| 3. | <b>Fasteners (screws, bolts and nuts) for higher temperature requirements</b> |                                  |   |  |   |
|    | MAN 183-B7  | Zinc-flake coating with top coat | Friction coefficients as per Section 6.7 do not apply | Delta-Protekt KL 120 + Delta-Heat<br>Zintek 200 +<br>2x Techseal Silver S-HAT<br>Geomet 321A +<br>2x Plus 10 | For increased requirements with respect to heat resistance and unfastening capability *) up to 400 °C<br>For material, see DIN 267-13 (e.g.: DIN 267-13-GA) |

\*) The unfastening capability shall remain guaranteed for fasteners. Copper-plated fasteners serve as a reference here which are used at MTB as standard in higher temperature ranges

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

Table 2 continued - Applications

|                   | Code                        | Corrosion protection system         | Lubrication/subsequent treatment             | Released systems **)                           | Comments   |
|-------------------|-----------------------------|-------------------------------------|--|--|--|
| 4.                | <b>Wheel bolts and nuts</b> |                                     |  |  |  |
| Normal case Bolts | MAN 183-B31                 | Zinc-flake coating without top coat | Lubricant coating                            | Geomet 500 +<br>Dacrolub 10                    | In the case of wheel bolts, a maximum layer thickness of 12 µm on the fitting surface shall not be exceeded. |
| Normal case Nuts  | MAN 183-B32                 | Zinc-flake coating with top coat    | Integrated lubrication,<br>Lubricant coating | Geomet 500 +<br>Plus VL +<br>microGleit DF 902 |  |

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

Table 2 continued - Applications

|             | Code                      | Corrosion protection system | Lubrication/subsequent treatment                     | Released systems **)          | Comments   |
|-------------|---------------------------|-----------------------------|--|-------------------------------|--|
| 5.          | Screws for thermoplastics |                             |  |                               |  |
| Normal case | MAN 183-B1                | Electroplated coating       | No lubricant additives<br>(integrated or additional) | ZnNi as per<br>M 3536 Type SV | In the case of plastic screws, the screws can come loose if there are reduced coefficients of friction.  |
|             | MAN 183-B4                |                             |  | ZnNi as per<br>M 3536 Type BV | In the case of plastic screws, the screws can come loose if there are reduced coefficients of friction.<br>Colour black due to design requirements |

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

Table 2 continued - Applications

|             | Code                | Corrosion protection system         | Lubrication/subsequent treatment                     | Released systems **)   | Comments   |
|-------------|---------------------|-------------------------------------|--|--|--|
| 6.          | Self-tapping screws |                                     |  |  |  |
| Normal case | MAN 183-B1          | Electroplated coating               | No lubricant additives<br>(integrated or additional) | ZnNi as per<br>M 3536 Type SV  | The max. layer thickness shall not restrict<br>screwability. |
|             | MAN 183-B4          | Zinc-flake coating<br>with top coat | No lubricant additives<br>(integrated or additional) | Delta Tone +<br>Delta Seal Black<br>(Geoblack)<br>blocked for<br>new designs | Colour black due to design requirements                      |
|             |                     | Electroplated coating               |  | ZnNi in accordance with<br>M 3536 Type BV                                    |  |
|             | MAN 183-B13         | Electroplated coating               |  | Zn in accordance with<br>DIN EN ISO 4042                                     | Use only in the interior and engine                          |

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

Table 2 continued - Applications

|             | Code        | Corrosion protection system                 | Lubrication/subsequent treatment                     | Released systems **)   | Comments  |
|-------------|-------------|---|--|--|---|
| 7.          | Wood screws |   |  |  |   |
| Normal case | MAN 183-B1  | Zinc-flake coating<br>Electroplated coating | No lubricant additives<br>(integrated or additional) | Geomet 321<br>Delta Protekt KL 100<br>ZnNi as per<br>M 3536 Type SV            | The max. layer thickness shall not restrict screwability.<br>In the event of procurement problems, it is possible to procure an alternative surface protection system:<br>MAN 183-B15 |
|             | MAN 183-B4  | Zinc-flake coating<br>with top coat         |  | Delta Tone +<br>Delta Seal Black<br>(Geoblack)<br>blocked for<br>new designs   | Colour black due to design requirements<br>In the event of procurement problems, it is possible to procure an alternative surface protection system:<br>MAN 183-B16                   |
|             | MAN 183-B13 | Electroplated coating                       |  | Zn in accordance with DIN<br>EN ISO 4042                                       | Use only in the interior and engine   |
|             | MAN 183-B15 |   |  | ZnFe in accordance with<br>DIN EN ISO 4042                                     |   |
|             | MAN 183-B16 |   |  | Colour black due to design requirements<br>Use only in the interior and engine |   |

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

Table 2 continued - Applications

|             | Code                                     | Corrosion protection system      | Lubrication/subsequent treatment     | Released systems **)                                      | Comments   |
|-------------|--|----------------------------------|--------------------------------------|---|--|
| 8.          | Thread rolling and thread cutting screws |                                  |                                      |   |  |
| Normal case | MAN 183-B1                               | Zinc-flake coating               | Lubrication appropriate for assembly | Geomet 321<br>Delta Protekt KL 100                        | DIN 7500-1<br>(for thread rolling screws)<br>or<br>DIN 7513 and DIN 7516<br>(for thread cutting screws)<br><br>Electroplated coating only for thread diameter < M6 |
|             |  | Electroplated coating            |                                      | ZnNi in accordance with<br>DIN EN ISO 4042<br>ZnNi8/Cn/T2 |  |
|             | MAN 183-B4                               | Zinc-flake coating with top coat |                                      | Delta Tone +<br>Delta Seal Black                          |  |

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

Table 2 continued - Applications

|                    | Code  | Corrosion protection system | Lubrication/subsequent treatment   | Released systems **)   | Comments   |
|--------------------|---|-----------------------------|--|--|--|
| 9.                 | <b>Pipe fittings and pipe and hose fasteners *)</b> |                             |  |  |  |
| <b>Normal case</b> | <b>MAN 183-B1</b>                                   | Electroplated coating       | No friction coefficient optimisation (normal case)<br><br>Exception: Union nuts as per DIN 3870 or DIN EN ISO 8434-1, lubrication on all sides as per M 3276, M 3222 | ZnNi, passivated, with inorganic sealing<br><br>ZnNi, passivated, with organic sealing<br><br>Zn, passivated, with organic sealing | Supplier-specific coating as per VDMA 24576<br><br>Corrosion resistance VDMA 24576 -K4 or -K5 ***)             |
|                    | <b>MAN 183-B4</b>                                   |                             | No friction coefficient optimisation (normal case)   | ZnNi, passivated, with inorganic sealing   | Colour black<br>Supplier-specific coating as per VDMA 24576<br>Corrosion resistance VDMA 24576 -K4 or -K5 ***) |

\*) Among other things, this includes hose fittings and ferrules, sealing nuts, lock nuts, measuring connections, flange connections, adapters, pneumatic and hydraulic couplings (e.g. plug-in and screw couplings), hydraulic valves (e.g. throttle valves, pressure limiting valves, directional control valves, and non-return valves), and valve control blocks.

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

\*\*\*) In the case of threaded pipe couplings, the corrosion resistance class K2 in accordance with VDMA 24576 is permitted for assessment of the media-carrying internal surfaces (bores) of these couplings.

Table 2 continued - Applications

|             | Code        | Corrosion protection system                 | Lubrication/subsequent treatment  | Released systems **)  | Comments   |  |
|-------------|-------------|---|---|---|--|--|
| 10.         | Washers     |   |   |   | **)  | Other corrosion protection systems will be added to Table 2 following release by MAN.. |
| Normal case | MAN 183-B1  | Zinc-flake coating<br>Electroplated coating | No lubricant additives<br>(integrated or additional)                          | Geomet 321<br>Delta Protekt KL100 / KL120<br>ZnNi as per<br>M 3536 Type SV                                      | At least 5 µm<br>Zinc flake coatings in normal case for nominal size ≥ 7.<br>Also possible for smaller nominal sizes for some forms.                   |  |
|             | MAN 183-B4  | Zinc-flake coating<br>with top coat         |   | Delta Tone +<br>Delta Seal Black<br>(Geoblack)<br>blocked for new designs                                       | At least 5 µm<br>Colour black due to design requirements<br>Reduction of the risk of contact corrosion   |  |
|             | MAN 183-B11 | Electroplated coating                       |   | ZnNi as per<br>M 3536 Type S  | For conductive contact points which were previously<br>coated with A2C/A3C<br>For higher conductivity requirements, stainless steel is<br>recommended. |  |
|             | MAN 183-B12 |   |   | ZnNi as per<br>M 3536 Type SV   | For higher abrasion resistance requirements  |  |
|             | MAN 183-B13 |   |   | Zn in accordance with<br>DIN EN ISO 4042  | Use only in the interior and engine  |  |
|             | MAN 183-B15 |   |   | ZnFe in accordance with<br>DIN EN ISO 4042  |  | Colour black due to design requirements<br>Use only in the interior and engine         |
|             | MAN 183-B16 |   |   |   |  |  |
|             | MAN 183-B7  | Zinc-flake coating<br>with top coat         |   | Delta-Protekt KL 120 +<br>Delta-Heat<br>Zintek 200 +<br>2x Techseal Silver S-HAT<br>Geomet 321A +<br>2x Plus 10 | For increased requirements with respect to heat re-<br>sistance up to 400 °C   |  |
|             | MAN 183-PHR | Phosphating                                 | Subsequent treatment on all<br>sides as per DIN EN ISO 9717<br>No lubrication | Znph/r/5/T4   | Special case<br>Very low corrosion resistance  |  |



Table 2 continued - Applications

|                    | Code   | Corrosion protection system                 | Lubrication/subsequent treatment   | Released systems **)   | Comments   |
|--------------------|--|---|--|--|--|
| 11.                | <b>General components (components that are not covered by the application areas 1 to 10)</b> |   |  |  |  |
| <b>Normal case</b> | <b>MAN 183-B1</b>  | Zinc-flake coating<br>Electroplated coating | No lubricant additives *)<br>(integrated or additional)                    | Geomet 321<br>Delta-Protekt KL 100<br>Magni B 46<br>ZnNi as per<br>M 3536 Type SV<br>etc.                          | Zinc-flake coatings are not suitable for adhesive bonding<br>Exception: Micro-encapsulation to secure fasteners in accordance with MAN 222 |
|                    | <b>MAN 183-B4</b>  | Zinc-flake coating<br>Electroplated coating |  | Delta Tone +<br>Delta Seal Black<br>ZnNi as per<br>M 3536 Type BV<br>(Geoblack)<br>blocked for new designs<br>etc. | Colour black<br>for design requirements  |
|                    | <b>MAN 183-B11</b>   | Electroplated<br>coating                    | No lubricant additives *)<br>(integrated or additional)                    | ZnNi as per<br>M 3536 Type S   | For higher abrasion resistance requirements<br>For conductive contact points which were previously coated with A2C/A3C                     |
|                    | <b>MAN 183-B12</b>   |   |  | ZnNi as per<br>M 3536 Type SV  | For higher abrasion resistance requirements  |
|                    | <b>MAN 183-PHR</b>   | Phosphating                                 | Subsequent treatment on all sides as per DIN EN ISO 9717<br>No lubrication | Znph/r/5/T4  | <b>Special case</b><br>Very low corrosion resistance   |

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

**Table 2 continued - Applications**

|     | Code  | Corrosion protection system      | Lubrication/subsequent treatment                        | Released systems **)  | Comments  |
|-----|---|----------------------------------|---|---|---|
| 11. | General components (components that are not covered by the application areas 1 to 10) |                                  |   |   |   |
|     | MAN 183-B13   | Electroplated coating            | No lubricant additives *)<br>(integrated or additional) | Zn in accordance with DIN EN ISO 19598  | Use only in the interior and engine                                     |
|     | MAN 183-B15   |                                  |   | ZnFe in accordance with DIN EN ISO 19598  |   |
|     | MAN 183-B16   |                                  |   |   |   |
|     | MAN 183-B7  | Zinc-flake coating with top coat |   | Delta-Protekt KL 120 +<br>Delta-Heat<br>Zintek 200 +<br>2x Techseal Silver S-HAT<br>Geomet 321A +<br>2x Plus 10 | For increased requirements with respect to heat resistance up to 400 °C |

\*) In cases with special functional requirements (e.g. for plate nuts), lubrication is permitted after consultation with the specialist department.

\*\*) Other corrosion protection systems will be added to Table 2 following release by MAN.

## 5 Changeover

Due to the end-of-life vehicles directive, many suppliers are no longer able to offer corrosion protection systems that contain Cr(VI), which means that these have to be replaced by corresponding alternatives.

The following procedure is used for the selection and introduction of alternative systems:

**Table 3**

|    |  |
|----|--|
| 1. | Enquire as to which alternative corrosion protection systems are offered.<br>If the system is unknown, organise test via the Materials Technology department if necessary. |
| 2. | Add the corresponding application (part type, Table 2) to MAN 183-3.   |
| 3. | First article inspection: Positive test shall confirm usability.<br>Entry of date of first article inspection<br>Determination of when changeover is to take place<br>Use  |
| 4. | Enter corrosion protection system into T127A release list.<br>Create material number for Cr(VI)-free system.<br>Add part type to release list if necessary.                |

## 6 Requirements

The general requirements as per the standards stated in Tables 1 and 2 apply, together with the following requirements:

### 6.1 Requirements to be met by the components before coating (see also DIN EN 26157-3)

The components to be coated shall not have any material, heat treatment, processing, or surface defects which could have an unfavourable influence on the corrosion resistance and quality of the corrosion protection systems. Examples of such defects include cracks, pore pockets, foreign matter inclusions, laminations or sink marks and cold corrosion spots, shrinkage and notch cracks, swirls and shrink holes.

The limit values required in DIN EN 26157-3 apply only to components that are covered by the scope of DIN EN 26157-3.

The requirements for edges and cut surfaces in accordance with M 3549 shall be noted and observed.

Components with high residual tensile stresses shall be annealed or stress-relieved immediately after the stresses are introduced or, at the latest, before a chemical or electroplating treatment. When doing so, the highest possible temperature is to be selected although this temperature shall not exceed the temperature of any preceding heat treatment.

For case-hardened or selectively surface hardened components, a duration of at least 2 hours at 180 °C to 200 °C applies, other than in the case of finish-rolled screws.

The dimensions and permissible deviations shall conform to the requirements in the applicable standards or drawings. This applies in particular for the threads.

Before application of the corrosion protection systems, the components shall be free from corrosion products of any kind as well as from dirt, grease, oils, and fingerprints.

## 6.2 General process requirements

All the treatments shall be carried out so that as little hydrogen as possible can be absorbed.

High-strength phosphated raw materials shall be dephosphated, particularly for component strengths of  $R_m \geq 1000 \text{ N/mm}^2$ , prior to the relevant heat treatment.

The treatment, coating, and lubricating materials applied shall not contain any chlorinated hydrocarbons, heavy metals, or other materials requiring identification in accordance with the dangerous goods regulations, shall not cause any skin irritation, and shall not be harmful to the environment.

The corrosion protection systems and lubricants shall be recoatable with the coatings named in M 3031, M 3094, and M 3162 without any adverse optical or chemical effects.

## 6.3 Preliminary treatment to activate the surfaces

Pickling treatments, in particular in cathodic baths, should be avoided where possible and mechanical or other cleaning procedures used instead.

Pickling shall occur in highly-effective electrolytes with suitable inhibitors which do not contain any promoters that favour an increase in hydrogen absorption. Pickling treatments in acids without inhibitors are not permitted.

The time between the preliminary treatment and application of the corrosion protection system shall be kept as short as possible.

If longer pickling periods cannot be avoided, a heat treatment suitable for high-strength components, for example 1 hour at 150 °C, shall be carried out in between.

## 6.4 Application of the corrosion protection systems

### 6.4.1 Phosphating

The phosphate coating shall be applied evenly with a structure as finely crystalline as possible and without any smudges and dirt residue, and it shall adhere securely to the surface of the component.

For high-strength mechanical fasteners of property class  $\geq 8.8/8$ , a micro-crystalline thin phosphate coating with a zinc phosphate base accordance with VDA 235-104.10 shall normally be applied in layer thicknesses of max. 5 µm.

In addition, the process, maximum permissible layer thickness and phosphate base shall be selected so that - after lubrication in accordance with Section 6.6 - the friction coefficients in Section 6.7 can be achieved reliably and no stick-slip effects can occur during tightening, even after long storage periods.

For other high-strength components, Znph/r/5/T4 in accordance with DIN EN ISO 9717 normally applies.

### 6.4.2 Electroplated coatings

Requirements for electroplated zinc and zinc-iron coatings are defined in DIN EN ISO 4042 and DIN EN ISO 19598, and the requirements for electroplated zinc-nickel coatings are documented in M 3536.

The coated components shall have a thick, even, and matt-finished coating with good adhesion and which does not flake off even when the component is twisted. They shall not have any large pores, cracks, rough areas, or spots.

### 6.4.3 Zinc-flake coatings

The general requirements in accordance with VDA 235-104.40 apply for coating MAN183-B1 (higher-strength fasteners in accordance with VDA 235-104.42). The requirements specified in VDA 235-104.50 apply to coatings MAN183-B4 and MAN 183-X1. The requirements VDA 235-104.43 apply to wheel bolts (MAN183-B31) and the requirements VDA 235-104.42 for wheel nuts (MAN183-B32). The stated standards apply in full if the standard MAN 183-3 does not define any deviating, limiting or supplementary requirements. The general requirements in accordance with VDA 235-104 also apply to MAN183-B7.

For coatings MAN183-B1, MAN183-B4, MAN183-B7 and MAN 183-X1, suitable application procedures shall be used, in particular in the case of internal threads, small external threads, and internal drives with scooping areas, to ensure that function and mountability are not adversely affected.

## 6.5 Heat treatment (annealing)

In order to expel the hydrogen absorbed during the coating procedure, or to make it ineffective, the following heat treatments shall be carried out on high-strength components if required.

**6.5.1** Components with strengths of  $R_m \geq 1200 \text{ N/mm}^2$  are to be subjected to a heat treatment of approximately 2 hours at 130 °C to 150 °C after phosphating in any case of doubt.

**6.5.2** The heat treatment of electroplated (Zn, ZnFe) components with strength  $R_m \geq 1000 \text{ N/mm}^2$  shall take place immediately and no more than 4 hours after electroplating and in all cases prior to passivation. Guide values with respect to temperature and holding periods as a function of the tensile strength of components are documented in DIN EN ISO 4042 and DIN EN ISO 19598.

The heat treatment of electroplated ZnNi components is described in M 3536.

## 6.6 Lubrication, subsequent treatment

For certain corrosion protection systems, it is necessary to carry out an additional lubrication in order to fulfil the friction coefficients in accordance with Section 6.7. In general, the requirements in Table 2 apply.

However, if "-OS" is stated in the designation after the code for the corrosion protection system, e.g. MAN 183-B4-OS, in deviation from the requirements in Table 2 no lubrication is required with a lubrication agent and therefore the friction values do not have to be met in accordance with Section 6.7.

The lubricants shall be tested in accordance with VDA 235-101 and M 3222 or M 3276 with respect to fulfilling the friction coefficients in accordance with Section 6.7; they shall be approved by MAN (see MAN approval list for M 3222) and shall not be changed, even for one specific part, without the agreement of MAN.

A visible greenish colouring of the lubricant film in accordance with M 3222 is required as proof of lubrication on higher- and high-strength fasteners with silver-grey Zn-flake coatings.

The greenish colouring of the lubrication does not apply to wheel fasteners with the surface protection MAN183-B31 and MAN183-B32. Transparent lubrication in accordance with M 3222 is required in these cases.

The lubricants shall be recoatable with the coatings standardised in M 3031, M 3094, and M 3162 without any adverse visual or chemical effects.

Micro-encapsulated screws in accordance with MAN 222 are not lubricated.

## 6.7 Friction coefficients

In order to reduce the friction coefficients and their spread in the thread and under the head, components with threads and corrosion protection systems as per this standard shall - to the extent required in Table 2, Section 6.6 - be treated with suitable lubricants as per Section 6.6 or by means of the lubricants already integrated into the systems (e.g. Teflon<sup>®</sup>) to achieve an overall friction coefficient of  $\mu_{\text{Total}} = 0,09 \text{ to } 0,14$  (target average value of  $\mu_{\text{Total}} = 0,11$ ).

Checking of the friction coefficients is part of the first article inspection. A maximum value of  $\mu_{\text{Total}} = 0,15$  is permitted on mating surfaces of bright steel. The test is performed as per VDA 235-203 or M 3222 in accordance with DIN EN ISO 16047 or if necessary in accordance with DIN 946.

## 6.8 Coating thicknesses of the corrosion protection systems

The layer thicknesses of the corrosion protection systems (recommended minimum values as per Table 1) including lubricant must fall within the limit values laid down in the applicable standards (DIN EN ISO 9717, VDA 235-104, and VDMA 24576) or in the drawings.

For the layer thicknesses in the thread, GO gauges of tolerance position 6h or 6H apply. The requirements of DIN ISO 1502 or VDA 235-104 apply. A deviating tolerance position for pipe fittings in accordance with Table 2.9 to 6g or 6G is permitted.

For nuts with the systems MAN183-B1, MAN183-B4, MAN183-B7, MAN183-B32 and MAN 183-X1, appropriate measures shall to be taken to ensure compliance with the specified layer thicknesses at the base of the thread and in scooping areas. In the case of wheel bolts, the maximum layer thickness on the fitting surface in the finished coated condition shall not exceed 12  $\mu\text{m}$ .

## 6.9 Resistance to hydrogen-induced brittle fracture

The proof of resistance to hydrogen-induced brittle fracture shall be provided in accordance with DIN 50969-1 /-2 or, if requested by MAN, by means of a bracing test as per Section 7.1 on at least 10 parts from a coating batch. The parts shall not have any incipient cracks or fractures.

## 6.10 Corrosion resistance and other requirements placed on the corrosion protection system

The required corrosion protection properties shall be achieved both when the part is in lubricated and unlubricated condition in accordance with Section 6.6. This does not apply to MAN183-PHR.

The requirements in M 3018 apply with regard to resistance to media. The adhesive strength shall be assessed in accordance with DIN EN ISO 10683 for non-electroplated systems and in accordance with DIN EN ISO 4042 and DIN EN ISO 19598 for electroplated systems.

The requirements in M 3018 apply with regard to recoatability of corrosion protection systems without lubrication. Corrosion protection systems with lubrication cannot normally meet the requirements for recoatability in accordance with M 3018. It is possible to assess the recoatability of corrosion protection systems with lubrication on the basis of their resistance to steam jet in accordance with M 3018 in recoated condition.

**Table 4 Corrosion resistance**

| Test load   | Corrosion protection system/test requirement |                         |                         |   |   |                          |
|---|--|-------------------------|-------------------------|---|---|--------------------------|
|   | MAN183-PHR <sup>4)</sup>                     | MAN183-B1 <sup>2)</sup> | MAN183-B4 <sup>2)</sup> | MAN183-B11 <sup>3)</sup>                  | MAN183-B12 <sup>3)</sup>                  |                          |
| Salt spray test<br>DIN EN ISO 9227 - NSS (h)                                  | 6  | 480/720 <sup>1)</sup>   | 480                     | 720 (normal area) /<br>480 (special area) | 720 (normal area) /<br>480 (special area) |                          |
|   |  |                         |                         |   |   |                          |
| Test load   | Corrosion protection system/test requirement |                         |                         |   |   |                          |
|   | MAN183-B13                                   | MAN183-B15              | MAN183-B16              | MAN183-B31 <sup>2)</sup>                  | MAN183-B32 <sup>2)</sup>                  | MAN 183-X1 <sup>2)</sup> |
| Salt spray test<br>DIN EN ISO 9227 - NSS (h)                                  | 120  | 240                     | 240                     | 720                                       | 720                                       | 720                      |
|   |  |                         |                         |   |   |                          |
| Test load   | Corrosion protection system/test requirement |                         |                         |   |   |                          |
|   | MAN183-B7 <sup>2)</sup>                      |                         |                         |   |   |                          |
| Hot storage 400 °C; 24 h<br>then salt spray test<br>DIN EN ISO 9227 - NSS (h) | 120  |                         |                         |   |   |                          |

<sup>1)</sup> Applies only to higher-strength fasteners

<sup>2)</sup> The corrosion resistance for fasteners shall be met independently of dimensions and, in deviation from VDA 235-104 (for zinc flakes), both at locations without thread and locations with thread.

<sup>3)</sup> See M 3536 Table 4 for definition of normal area and special area

<sup>4)</sup> The test is permitted only before any transport operations

The components shall not have any base metal corrosion (red rust) after the test load.

## 6.11 Finish rolling

If the term FINISH ROLLED is entered in the designation in the item master data (purchase order and delivery call-off), this means that special requirements are placed on the coated threads in the case of external threads (screws) in deviation from DIN EN 26157-1 and 3.

Any damage to the thread caused by production and/or coating processes (knocks or localised coating concentrations on the thread root) shall be rectified by means of a finish rolling procedure in order to avoid stressing leading to thread seizure.

The finish rolling process shall be such that a GO screw ring gauge with tolerance position 6h as per DIN ISO 1502 can be screwed onto the entire length of the thread by hand without particular force.

The thread geometry, corrosion protection, and friction coefficients (lubrication) shall not be restricted to an impermissible extent by the finish rolling process.

If the production process is set up in such a way that no damage can occur in the thread root and/or there can be no local coating concentrations on the thread root, then finish rolling is not required.

Finish rolling shall be required only in proven individual **problematic cases**, in particular for M 16 and higher, and can be initiated **only** by the **assembly department** due to **problems** in the assembly process.

The term FINISH ROLLED is entered in the designation in the item master data by the Standardization department.

FINISH ROLLED cannot be defined as a standard requirement in assembly drawings. Entry of the term FINISH ROLLED in the item master data is not permitted for newly documented screws and bolts.

If screws and bolts are already documented with the suffix FINISH ROLLED in the item master data, these can also then be entered correspondingly in the assembly drawings.

## 7 Tests

The provisions laid down in the quoted standards apply.

When testing new corrosion protection systems, the adhesive strength, recoatability, and resistance to media as per M 3018 shall be examined in addition to the corrosion resistance (also see Section 6.10).

The positions to be used for corrosion resistance and to determine the layer thicknesses shall be selected in consultation with the MAN quality departments. In cases of doubt, the microscopic determination of the local layer thickness in accordance with DIN EN ISO 1463 shall apply, e.g. on the head or key surfaces.

### 7.1 Bracing test

In deviation from DIN 50969, the following test conditions apply for the bracing test:

The bracing test shall be carried out at the latest 24 hours after the components have been removed from the coating bath.

The components (if applicable, replacement test parts) shall be braced until there is a plastic deformation of 1% minimum and 10% maximum of the elastic spring travel. They shall be kept in this bracing condition at 20 °C for 96 hours.

Threaded parts are to be lubricated before bracing to an overall friction value of  $\mu_{\text{Total}} = 0,09 - 0,14$ .

After dismantling, the components shall be checked visually for incipient cracks and fractures.

In any case of doubt, a bending test and a magnetic crack test shall be carried out.

The results shall be documented in line with Section 2 and DIN 50969 -1/-2.

**Appendix A: Corrosion release of the systems in accordance with MAN 183-3; System/material item numbers**

(The released systems are listed only by way of example in Appendix A. The entries in the host screen T127A are decisive.)

| System/material item number | Designation of system/material item number  | Code | Released systems  | Note |
|-----------------------------|---|------|---|------|
| 04.10006-0601               | MAN 183 - B1 with lubrication (720h NSS)    | B1   | Delta Protekt KL 100<br>+ Delta-Lube 10   |      |
|                             |   |      | ZnNi as per M 3536 Type SVR   |      |
| 04.10006-0602               | MAN 183 - B1 without lubrication (720h NSS) |      | Delta Protekt KL 100  |      |
|                             |   |      | ZnNi as per M 3536 Type SV  |      |
| 04.10006-0603               | MAN 183 - B1 with lubrication (480h NSS)    |      | Geomet 321<br>+ lubrication appropriate for assembly  |      |
|                             |   |      | Delta Protekt KL 100<br>+ lubrication appropriate for assembly  |      |
|                             |   |      | ZnNi in accordance with<br>DIN EN ISO 19598 / 4042<br>ZnNi8//CN//T2<br>+ lubrication appropriate for assembly |      |
| 04.10006-0604               | MAN 183 - B1 without lubrication (480h NSS) |      | Geomet 321  |      |
|                             |   |      | Delta Protekt KL 100  |      |
|                             |   |      | Delta Protekt KL 120  |      |
|                             |   |      | Magni B 46  |      |
|                             |   |      | ZnNi as per M 3536 Type SV  |      |
|                             |   |      | ZnNi passivated –<br>as per VDMA 24576  |      |



| System/material item number | Designation of system/material item number   | Code | Released systems  | Note |
|-----------------------------|--|------|---|------|
| 04.10006-0605               | MAN 183 - B4 with lubrication (480h NSS)     | B4   | Delta Tone + Delta Seal with lubrication                            |      |
|                             |  |      | ZnNi as per M 3536 Type BVR   |      |
| 04.10006-0606               | MAN 183 - B4 without lubrication (480h NSS)  |      | Delta Tone + Delta Seal   |      |
|                             |  |      | ZnNi as per M 3536 Type BV  |      |
| 04.10006-0610               | MAN 183 - B11 without lubrication (720h NSS) | B11  | ZnNi as per M 3536 Type S   |      |
| 04.10006-0614               | MAN 183 - B12 without lubrication (720h NSS) | B12  | ZnNi as per M 3536 Type SV  |      |
| 04.10006-0618               | MAN 183 - B13 without lubrication (120h NSS) | B13  | Zn in accordance with<br>DIN EN ISO 19598 / 4042                    |      |
| 04.10006-0617               | MAN 183 - B13 with lubrication (120h NSS)    | B13  | Zn in accordance with<br>DIN EN ISO 19598/ 4042<br>+ lubrication    |      |
| 04.10006-0622               | MAN 183 - B15 without lubrication (240h NSS) | B15  | ZnFe in accordance<br>with DIN EN ISO 19598 / 4042                  |      |
| 04.10006-0621               | MAN 183 - B15 with lubrication (240h NSS)    | B15  | ZnFe in accordance<br>with DIN EN ISO 19598 / 4042<br>+ lubrication |      |
| 04.10006-0626               | MAN 183 - B16 without lubrication (240h NSS) | B16  | ZnFe in accordance<br>with DIN EN ISO 19598 / 4042                  |      |
| 04.10006-0625               | MAN 183 - B16 with lubrication (240h NSS)    | B16  | ZnFe in accordance<br>with DIN EN ISO 19598 / 4042<br>+ lubrication |      |
| 04.10006-0629               | MAN 183 – PHR with oiling (6h NSS)           | PHR  | Znph/r5/T4  |      |
| 04.10006-0635               | MAN 183 - B31 with lubrication (720h NSS)    | B31  | Geomet 500<br>+ Dacrolub 10   |      |
| 04.10006-0639               | MAN 183 - B32 with lubrication (720h NSS)    | B32  | Geomet 500<br>+ Plus VL<br>+ microGleit DF 902                      |      |

| System/material item number | Designation of system/material item number   | Code | Released systems  | Note |
|-----------------------------|--|------|---|------|
| 04.10006-0643               | MAN 183 – B7 without lubrication (120 h NSS) | B7   | Delta-Protekt KL 120<br>+ Delta-Heat<br>Zintek 200 +<br>2x Techseal Silver S-HAT<br>Geomet 321A +<br>2x Plus 10 |      |
| 04.10006-0645               | MAN 183 – X1 with lubrication (720 h NSS)    | X1   | Delta Protekt KL120<br>+ VH 321 GZ  |      |

## Applicable documents

|                   |  |
|-------------------|--|
| CVS16             | Coating systems  |
| DIN 267-13        | Fasteners - Technical specifications - Part 13: Parts for bolted connections with specific mechanical properties for use at temperatures ranging from -200 °C to +700 °C |
| DIN 3870          | Non-soldering and soldering compression fittings - Union nuts  |
| DIN 50969-1       | Prevention of hydrogen-induced brittle fracture of high-strength steel components - Part 1: Preventive measures  |
| DIN 50969-2       | Prevention of hydrogen-induced brittle fracture of high-strength steel components - Part 2: Tests  |
| DIN 931           | Hexagon head bolts, metric thread  |
| DIN 946           | Determination of coefficient of friction of bolt/nut assemblies under specified conditions   |
| DIN EN ISO 1463   | Metallic and oxide coatings - Measurement of coating thickness - Microscopical method  |
| DIN EN 26157-1    | Fasteners; surface discontinuities; bolts, screws and studs subject to general requirements  |
| DIN EN 26157-3    | Fasteners; surface discontinuities; bolts, screws and studs subject to special requirements  |
| DIN EN ISO 16047  | Fasteners - Torque/clamp force testing   |
| DIN EN ISO 19598  | Metallic coatings - Electroplated coatings of zinc and zinc alloys on iron or steel with supplementary Cr(VI)-free treatment   |
| DIN EN ISO 4042   | Parts with threads - Electroplated coatings  |
| DIN EN ISO 6270-2 | Paints and varnishes - Determination of resistance to humidity - Part 2: Procedure for exposing test specimens in condensation-water atmospheres                         |
| DIN EN ISO 9717   | Metallic and other inorganic coatings - Phosphate conversion coating of metals   |
| DIN EN ISO 9227   | Corrosion tests in artificial atmospheres - Salt spray tests   |
| DIN ISO 1502      | ISO general purpose metric screw threads - Gauges and gauging  |
| M 3018            | Corrosion protection and coating systems for purchased parts   |
| M 3031            | Single-component top coating materials, 1K top coat; technical terms of delivery   |
| M 3094            | Two-component top coating materials, 2K top coat; technical terms of delivery  |
| M 3162            | 2K base coating materials, primer; technical terms of delivery   |
| M 3222            | Lubricants for screw connections; technical terms of delivery  |
| M 3276            | Lubricant coating of pipe fasteners  |
| M 3296            | Pan-head tapping screws with hexalobular socket  |
| M 3536            | Electroplated ZnNi coating on ferrous materials, surface protection requirements   |
| M 3539            | Contact corrosion – influencing variables and measures   |
| M 3549            | Edge and cut surface quality on components made of metallic materials  |
| MAN 183-2         | Corrosion protection coatings for high-strength fasteners and other components   |
| MAN 239-1 ff.     | General terms of delivery for purchased parts, all parts   |
| VDA 235-101       | Lubrication of mechanical fasteners with threads   |
| VDA 235-104       | Cr(VI)-free types of surface protection for fasteners with metric threads  |
| VDA 235-203       | Screw fastening behaviour, friction coefficients - Practical and assembly-oriented testing   |
| VDMA 24576        | VDMA standard sheet: Fluid technology; requirements and designations for corrosion protection layers without hexavalent chromium   |

**Previous issues:** E MAN 183-3/2008-09  
MAN 183-3/2010-03, 2010-04, 2010-11, 2011-04; 2011-06; 2011-09; 2012-05;  
2013-06, 2014-01, 2014-08, 2015-09, 2015-10; 2015-12; 2016-06; 2016-10; 2016-12,  
2017-06; 2018-02; 2019-11; 2020-01; 2020-07; 2020-08; 2020-09; 2021-01

**Changes:** Compared to issue 2020-01 the following changes have been made:

- Section 2: Release note added
- Section 3.2: Added as new section
- Table 1: split in to Tables 1a and 1b  
New coating system X1 added
- Table 2.1: X1 added  
Note for B4: Recommendation: Now only in the interior
- Table 2.9: Reference to corrosion protection requirements (index \*\*\*) added

Compared to issue 2020-07 the following changes have been made:

- Section 6.1: Reference to DIN EN 26157-3 added

Compared to issue 2020-08 the following changes have been made:

- Table 4: Correction of test requirements for coating system X1

Compared to issue 2020-09 the following changes have been made:

- Tables 1a and 1b: Index 12 added  
The minimum layer thickness was adapted for MAN 183-B13.  
Index 13 added

Compared to issue 2021-01 the following changes have been made:

- The reference was changed from DIN EN ISO 19598 to DIN EN ISO 4042  
for fasteners
- Table 2.10: Delta Protekt KL 120 added for B1