

INDIAN RAILWAYS



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Document content	Technical Specification	Yes
	Schedule of Technical Requirement	Yes
Description of Item	FASTENERS FOR BOGIES OF PASSENGER COACHES	
Remarks	-----	

S. No.	Month/Year of issue	Revision / Amendment	Page No.	Reason for Amendment/Revision
1.	September, 2024	Nil	-	First Issue

Issued by:

CARRIAGE DIRECTORATE
Research Designs and Standards Organization
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SCHEDULE OF TECHNICAL REQUIREMENTS FOR PLAIN NUT, ALL METAL PREVAILING TORQUE TYPE HEXAGON NUTS, BOLTS, PINS, WASHERS AND SCREWS ETC. FOR BOGIES OF PASSENGER COACHES

1.0 SCOPE

- 1.1 This specification covers the guideline for evaluation of firms for manufacturing & testing of various types of fasteners to be used in bogies of passenger coaches.
- 1.2 Referred Documents: Latest version of all the referred documents shall be followed.

S. No.	Standard No.	Standard Title
1.	ISO 4017	Hexagon head bolts with thread up to head
2.	ISO 4014	Hexagon head bolts with shank
3.	IS 1364–1	HEXAGON HEAD BOLTS, SCREWS AND NUTS OF PRODUCT GRADES A AND B
4.	IS 1364–2	HEXAGON HEAD BOLTS, SCREWS AND NUTS OF PRODUCT GRADES A AND B
5.	IS 1367–3	TECHNICAL SUPPLY CONDITIONS FOR THREADED STEEL FASTENERS
6.	DIN 609	Hexagon fits bolts with long thread
7.	ISO 4032	Hexagon Nuts
8.	IS 1364–3	HEXAGON HEAD BOLTS, SCREWS AND NUTS OF PRODUCT GRADES A AND B
9.	IS 1367–6	TECHNICAL SUPPLY CONDITIONS FOR THREADED STEEL FASTENERS
10.	IS 5556	IS 5556: Serrated Lock Washers
11.	DIN 6798A	Serrated lock washers, Form I - external
12.	ISO 2320	Prevailing torque type steel nuts -- Mechanical and performance properties
13.	IS 1367–8	Technical Supply Conditions for Threaded Steel Fasteners, Part 8: Prevailing Torque Type Steel Hexagon Nuts - Mechanical and Performance Properties
14.	DIN 6925	Hexagon nuts with clamping part all-metal nuts,
15.	DIN 980	DIN 980 (Type V or M) - All Metal Prevailing Torque Type Hexagon Nuts.
16.	ISO 7089	Plain washers — Normal series — Product grade A
17.	EN 28738	Flat washers for clevis pins
18.	ISO 7093-1	Plain washers — Large series
19.	IS 2269	Hexagon Socket Head Cap Screws
20.	ISO 4762	Hexagon socket Head Cap Screws
21.	IS 6094–1	HEXAGON SOCKET SET SCREWS
22.	ISO 898–5	Mechanical properties of fasteners made of carbon steel and alloy steel —
23.	IS 6761	FASTENERS- COUNTER SUNK HEAD SCREWS WITH HEXAGON SOCKET SPECIFICATION
24.	ISO 10642	Hexagon socket countersunk head screws
25.	DIN 910	Hexagon Head Screw Plugs, Heavy Type, Cylindrical Thread
26.	ISO 2341	Clevis pins with head
27.	ISO 1234	Split pins
28.	ISO 9227	Corrosion tests in artificial atmospheres — Salt spray tests
29.	ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus1
30.	ISO 4042	Fasteners - Electroplated coatings
31.	ISO 10683	Fasteners — Non-electrolytically applied zinc flake coatings
32.	EN 13858	Corrosion protection of metals - Non-electrolytically applied zinc flake coatings on iron or steel components
33.	IS 1367–11	TECHNICAL SUPPLY CONDITIONS FOR THREADED STEEL FASTENERS – Electroplated Coatings
34.	ISO 3269	Fasteners — Acceptance inspection
35.	ISO 898–1	Mechanical properties of fasteners made of carbon steel and alloy steel

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		Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread
36.	ISO 898-6	ISO 898-6 - Mechanical properties of fasteners made of carbon steel and alloy steel - Part 6: Nuts with specified proof load values - Fine pitch thread (ISO/DIS 898-6:2010)
37.	DIN 65151 & DIN 25201-4	Interlock washers
38.	IS 1363-3	Hex Head bolts, screws and nuts of product grade-C
39.	ISO 3800	Axial load fatigue testing of fasteners
40.	IS 3063	Spring lock washers
41.	ISO 1207	Slotted cheese head screws
42.	ISO 7040	Prevailing torque type hexagon nuts
43.	IS 1367 - 17	TECHNICAL SUPPLY CONDITIONS FOR THREADED STEEL FASTENERS - Inspections, Sampling and Acceptance Procedure
44.	ISO 148-1	Metallic materials — Charpy pendulum impact test

2.0 WEATHER CONDITION

2.1 The Fasteners are used very widely under the severe weather conditions. The limiting conditions, which have to be withstood in service, are indicated as below:

S. No.	Weather condition	Limiting conditions
1	Maximum temperature	+70° C
2	Minimum temperature	-20° C
3	Max. temperature attainable by an object exposed to sun(current carrying object)	100° C
4	Maximum Relative humidity	Up to 100%
5	Average Annual Rainfall	1750 to 6250 mm
9	Maximum wind pressure	200 Kg/Sq. meter
10	Altitude	Up to 3000 m
11	The Fasteners are subjected to chemical pollution from the effluent gases of Chemical Plants and saline atmosphere in coastal areas.	

2.2 Coach-body displacement encountered under dynamic conditions.

i)	Vertically-	±100 mm
ii)	Laterally -	±126 mm
ii)	Longitudinally-	±10 mm
iii)	Bogie rotation about center pivot-	±4°
iv)	Maximum Speed of train -	200 KMPH

3.0 GENERAL REQUIREMENTS

3.1 All firms requires registration for manufacturing, testing & supply of various types of fasteners to be used in bogies of passenger coaches should be well established. This STR/Specification specified details requirement for various fasteners. However, the firm applying for registration shall ensure compliance of relevant clauses & requirement of M&Ps & T&Ps for items for which it applies for registration.

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- 3.2 Their manufactured fasteners should have been used in Railways, Wind Mills, Turbines, Ships, Aerospace, Bridges, Heavy Transport/Commercial Vehicles or Earthmovers.
- 3.3 The manufacturer shall have design capabilities with CAE Analysis software and R&D facilities. The firm should have experienced employee(s) in the field of CAE and CAD with a minimum experience of 5 years.
- 3.4 Manufacturer with well-established facilities and minimum annual Capacity of the firm shall be 2,50,00,000 nos.
- 3.5 Manufacturers shall apply for Bolt and/or Screws and/or Washers and/or Pins etc.

4.0 SPECIFICATION FOR FASTENERS

Specifications mentioned in below table shall be used for manufacturing, Testing, Marking & Delivery of fasteners:

Types of Fasteners	Size Range	Properties Range	Hardness Range	Material/Quality Standard	Coating Requirement
Hex. Head Bolt / Screw / Stud/ Fit Bolt	M8 to M30	8.8 to 12.9	-	ISO:4017 / ISO:4014 / IS:1364 PT-1 / IS:1364 PT-2 / IS:1367 PT-3 / DIN 609	Minimum 1000 hours salt spray test according to ISO 9227 / ASTM B117/ ISO 10683
Hex. Nut	M8 to M30	8 to 12	-	ISO: 4032 / IS: 1364 PT-3 / IS: 1367 PT-6	
Serrated Washer	M8 to M30	-	430HV to 530 HV as per IS 5556 & 350 HV to 425 HV as per DIN 6798	IS:5556 Type A & B / DIN 6798 A	
Hex. Nut Prevailing Torque Type	M8 to M30	8 to 12		ISO: 2320 / IS:1367 PT-8 / DIN 6925 / DIN 980V	
Plain Washer	M8 to M33	-	200HV to 400HV	ISO: 7089 / EN 28738 / ISO: 7093-1	
Hex Socket Head Cap Screw	M8 to M30	8.8 to 12.9	-	IS: 2269 / IS: 1367 PT-3 / ISO: 4762	
Hex Socket Head Screw with Flat Point	M8 to M30	8.8 to 12.9	-	IS: 6094 PT-1 / ISO: 898 PT-5	
Hex Socket Counter Sunk Head Screw	M8 to M30	8.8 to 12.9	-	IS:6761 / ISO: 10642	

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Hex Head Plug Screw	M8 to M30	8 to 12.9	-	IS: 1367 PT-3 / DIN 910
Clevis Pins with Head / Split Pins	M8 to M36	-	125 HV to 245 HV as per ISO 2341 & Split Pin is as per ISO 1234	ISO 2341 / ISO 1234
Interlock washers	M8 to M30	-	47≤HRC	DIN 65151/DIN 25201-4

5.0 DRAWINGS AND DIMENSIONS

Fasteners of Standard Size(s) will be used if Drawings & dimension for specific fasteners not specified in Tender Document.

6.0 THREAD FORMATION

- 6.1 External Threads should be formed by cold rolling process and thread profile shall confirm to ISO 965-1, tolerance class 6g. Internal threads should be formed by tapping process and thread profile shall confirm to ISO 965-1, tolerance class 6H.
- 6.2 The thread profile shall be checked/measured by traveling microscope or profile projector in addition to conventional thread gauge.

7.0 SURFACE PROTECTION (See Annexure-I)

- 7.1 Products of water-based family containing metallic zinc & Aluminum flakes shall be used for coating on fasteners. Thermal curing of coating shall also be ensured.
- 7.2 Coating procedure shall confirm to ISO 10683 / EN 13858. Coating thickness shall be 0.008 mm to 0.015 mm.
- 7.3 After 1,000 hours of salt spray chamber exposure, the fastener shall not exhibit any red rust.
- 7.4 Surface protection of the fasteners should be as specified in the drawings/Tender Documents/POs.
- 7.5 After coating, ISO metric screw threads shall be gauged in accordance with ISO-1502 with a go gauge of tolerance portion 'h'.
- 7.6 H2DE test shall be conducted for the fasteners of property class 10.9 and above for hardness exceeding 36 HRC.

8.0 PLANT, MACHINERY AND INFRASTRUCTURAL REQUIREMENTS FOR MANUFACTURING AND TESTING

- 8.1 The manufacturers shall have adequate space and covered area with cemented floor to accommodate the following:
- Damp free place for storage of solid wire, extruded rods, dies, chemicals and other raw materials including bought out items.
 - Independent manufacturing areas for various components.
 - Place for Inspection of Finished/Semi-Finished Products.
 - Place for Chemical Mechanical Testing Lab.
 - Place for Storage of Finish Goods.

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8.2 Following machines/equipment shall be available (In-House or at Sister Concern Facility) with the manufacturers for manufacturing of fasteners for use in bogies of Passenger Coaches.

- i) The manufacturer shall have at least one Annealing Furnace.
- ii) Cleaning Line / Chamber
- iii) Wire drawing machine
- iv) Cold Forging Machines with min. & max. Dia. & Length and Hot Forging Machines with min. & max. Dia. & Length.
- v) Continuous Heat Treatment Furnace (Hardening, Oil Quenching & Tempering), Sealed quenching facility or continuous mesh belt atmosphere controlled furnace shall be available.
- vi) Head Trimming Machines.
- vii) Threads Rolling Machines & Thread Tapping Machines.
- viii) Coating Chamber / Room / Tank along with other facility for coating of fasteners as per this specification. Facility for zinc flake coating may be in-house or outsource. If outsource, MOU/ Contract with outsourced agencies to be submitted
- ix) Shot Blasting Chamber / Room using stainless Steel shots of sizes 0.250mm/0.275mm.
- x) CNC Machines for Machining
- xi) Salt Spray Chamber
- xii) Hydraulic Press Machine
- xiii) Punching/Blanking Machine
- xiv) Coating Thickness Gauge
- xv) Digital pH Meter
- xvi) Digital Coating Weighing Machine
- xvii) Lab Oven
- xviii) Hydrometer
- xix) Microprocessor Controlled furnace(s)
- xx) Knurling machine
- xxi) Vacuum furnace

8.3 Testing facilities required for manufacturing and supply of fasteners for use in Bogies of Passenger Coaches are as below:

- i) Microscope/Profile projector for threads laps.
- ii) Spectroscope (For chemical composition testing)
- iii) Universal/Tensile Testing Machine
- iv) Impact Testing Machine
- v) Microscope for Measurement of Decarburization
- vi) Thermocouples (Part of HT Furnace)
- vii) Magna Flux for crack detection.
- viii) Adequate no. of measuring instruments and gauges (Vernier calipers/Screw Gauges, Thread Plug Gauge, Thread Ring Gauge, Go-No-Go gauges etc.).
- ix) Torque Wrench with load indicating device
- x) Automatic shorting parts machine for dimensional check, crack, hardness, marking etc.
- xi) Junker Vibration Testing Machine for Interlock Washers.
- xii) Surface Hardness testing Machine (HV 0.3).
- xiii) Positive material identification machine.
- xiv) Torque Tension Testing Machine.
- xv) Surface Roughness testing Machine.
- xvi) Compression testing machine upto 2000 KN
- xvii) Widening testing setup.
- xviii) Preload testing Machine.

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- xix) Automatic temperature Control Cooling Chamber.
- xx) Surface Plate
- xxi) Tensile testing
- xxii) Ultrasonic bolt elongation testing
- xxiii) Fatigue testing
- xxiv) Hardness testing
- xxv) Contour graph
- xxvi) Surface integrity
- xxvii) Millipore apparatus

Note: Whenever inspecting authority advises for third party testing, the testing shall be done in RDSO Lab/NTH/NABL accredited lab/NML only.

Fatigue Test of Fasteners (para no. 8.3 (xxiii)) to be done as per DIN969/ISO 3800/DIN65151/DIN25201-4 during prototype test only. Facility for the same may be with Sister concern unit or third party lab.

9.0 Manufacturing

- 9.1 All the fasteners shall be manufactured by cold forming process and Heat treatment of fasteners shall be done before rolling process (Thread Cutting) to ensure good quality of fasteners.
- 9.2 Marking and Manufacturer's identification shall be done in accordance with clause - 10 of ISO 898-1 for bolts, screws and studs and clause - 10 of ISO - 898 -2 for nuts.

10.0 PROPERTIES OF MATERIAL

- 10.1 Physical & Chemical Properties of each type of fasteners shall be checked/verified by the manufacturer as per the requirements of respective ISO/IS/EN/ASTM etc. standard for each lot. The same shall be inspected by RDSO/Purchaser/Inspecting Agency. Manufacturer shall provide free of charge labor, M&P/T&P and space for inspection/testing by RDSO/Purchaser/Inspecting Agency.

11.0 Quality Control Requirements

- 11.1 The manufacturer shall have valid ISO: 9001:2015 certification, ISO 45001:2018 certification, Zed certification for MSME only, IATF 16949 certification, ISO 14001:2015 certification and IRIS certification.
- 11.2 There should be the system to ensure 'first-in first-out' for all raw materials and intermediate stages to finish products. Separate storage for raw material and Finish Goods shall be available.
- 11.3 It should be ensured that there is a Quality Assurance Plan for the product detailing the following various aspects:
 - Organisation chart
 - Process flow chart
 - Stage inspection details from raw materials stage to finish product stage
 - Various parameters to be checked and level of acceptance of such parameters indicated and method to ensure control over them.
 - Disposal system of rejected raw material and components.
- 11.4 The quality manual of the firm for ISO: 9001 should clearly indicate the control over manufacturing at every stage and testing of the said Railway product.
- 11.5 It should be ensured that proper analysis is being done on monthly basis to study the

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rejection at various stages of production and is documented.

- 11.6** There shall be at least one graduate degree holder person in relevant technology with field experience of at least five years or diploma holder with field experience of ten years on production/metallurgy/Quality Control for regular production, Testing and Quality Control.
- 11.7** Latest version of all the relevant specification either referred or otherwise (IS, BS, ISO, EN, ASTM, UIC, NCD, RDSO, ICF, RCF, MCF) and drawings with latest alterations should be available with the firm.
- 11.8** The manufacturer shall have min. 10 years of successful manufacturing experience of fasteners for applications such as Railways, Wind Mills, Turbines, Ships, Aerospace, Bridges, Heavy Transport/Commercial Vehicles and Earthmovers.
- 11.9** The manufacturer shall have BIS 1364 Part -1 & BIS 1364 Part -2 Certification or equivalent certification.
- 11.10** The manufacturer shall have in-house NABL Accredited Lab for Testing.
- 11.11** Manufacturer shall submit past Performance letter /certificate of same or similar grade items. (minimum from 2 customers)
- 11.12** Each and every fastener should be tagged with Raw material, batch number, machineries handled, men handled and testing done.
- 11.13** The firm shall have a system of component level traceability from raw material to the finished product.

12.0 Inspection and Tests

Inspection shall be carried out at the manufacturer's premises by the RDSO or Purchaser or their nominated inspection agency. Manufacturer shall have to arrange free of charge labor, M&P/T&P for inspection. Manufacturer shall also associate for the following:

- i) Access to all records considered relevant for such activity by inspecting authority.
- ii) Questioning of relevant personnel engaged in production, testing and quality checking activities etc. or related issues.

13.0 Inspection by Manufacturer/Purchaser/RDSO:

Inspection of fasteners shall be carried out as per ISO 3269 and IS 1367-17 and AQL shall be taken as 0.65 and 1 as applicable & LQ₁₀ shall be taken as 3.0.

13.1 Visual Inspection:

- i) 100% bars/wires shall be visually inspected at every stage of the production. The components shall have smooth finish and free from all visual defects like pinholes, scratches etc.
- ii) Adequate number of samples selected randomly from each lot shall be passed through NDT and destructive test.

13.2 Dimensional Accuracy:

- I) Dimensional accuracy of the fasteners shall be strictly in accordance to the relevant drawings/ Standard/ Specifications.
- II) The coating thickness shall be checked to ensure the minimum required thickness.

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Tensile and Impact Test:

- i) Tensile and Impact testing on the adequate number of samples (1 /heat or 1/lot) shall be ensured.
- ii) The mechanical properties of the fasteners shall be recorded and presented to RDSO/Purchaser/Inspecting Authority as and when required.

14.0 Upgradation Quantity:

Minimum Supplies of Bolts/Screws or Nuts/Prevailing Torque Nuts or Washers shall be 25,00,000 nos.

15.0 Warranty:

All fasteners shall not exhibit any defect/deformation for a period of 36 months in service or 48 months from supply for Bolt/Screws/Studs/Pins. Warranty for other fasteners including nut, washers shall be governed by IRS condition of contract.

16.0 Marking:

All fasteners shall have identification marking on heads or appropriate places and contain at least following parameters:

- i. Manufacturer's Code
- ii. Property Class
- iii. MM YY

17.0 Packing:

All fasteners shall be packed properly to avoid any damage to threads during transit & storage by masking of threads.

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Annexure -ISURFACE TREATMENT FOR NON-ELECTROLYTICALLY APPLIED ZINC & ALUMINIUM FLAKE COATINGS FOR FASTENERS**1.0 Scope:**

This specification covers the requirements for non-electrolytically applied zinc & Aluminium flake coatings for steel fasteners. It applies to coatings with or without hexavalent chromium; with or without top coat; with or without lubricant (integral lubricant and/or subsequently added lubricant).

It applies to bolts, screws, studs and nuts with ISO metric thread, to fasteners with non-ISO metric thread, and to non-threaded fasteners such as washers, pins, clips, etc. It does not apply to mechanically applied zinc coatings.

This specification is intended to help better understanding of the codal provisions. For actual design/ use the relevant reference codes as given in para 2 below shall be referred to and followed. In case of any confusion, clarification or difference of opinion etc., the provisions given in the relevant reference codes as given in para 2 below shall prevail.

2.0 Reference Codes:

Following codes has been referred while preparation of this specification:

2.1 ISO 10683:2018 (Fasteners — Non-electrolytically applied zinc flake coating systems)

2.2 EN 14399 Series (High strength structural bolting assemblies for preloading)

2.3 EN 13858 (Corrosion protection of metals - Non-electrolytically applied zinc flake coatings on iron or steel components)

3.0 General Characteristics of the Coating:**3.1 Metallic Zinc & Aluminium Flake coating systems**

Metallic Zinc & Aluminium flake coating systems are produced by applying zinc flake dispersion to the surface of a steel fastener, usually with the addition of aluminium flakes, in a suitable medium. Under the influence of heat (curing), a bonding amongst flakes and also between flakes and substrate is generated, thus forming an inorganic surface coating sufficiently electrically conducting to ensure cathodic protection. The coating may or may not contain hexavalent chromium, Cr(VI).

Special techniques may be necessary to avoid excessive or insufficient coating thickness. Special techniques may be necessary to prevent lightweight and/or flat fasteners from sticking together (e.g. washers, clips, fasteners with captive washer, flanged nuts).

An additional top coat can be applied to increase corrosion resistance and/or to achieve specific properties (e.g. torque/tension properties, chemical resistance, aspect, colour, electrical insulation/conductivity).

3.2 Functional properties**3.2.1 Assemblability and Mountability**

Clearance between assembly components (e.g. clearance hole), dimensional tolerances of the functional parts of the fasteners, tool gripping (e.g. for retaining rings), tool insertion (e.g. for recess and internal drives) and driving should not be impaired.

For dimensional requirements after coating for threaded fasteners, (see 5.2 of this document and Annex B of reference code at para 2.1).

The compatibility of the coating system with the tightening process, especially when high speed tightening is foreseen (risk of overheating, stick/slip, etc.) should be considered. The compatibility of the coated fasteners with the clamped parts, e.g. tapped holes, clamped parts in aluminium,

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magnesium, stainless steel, electrophoretically coated parts, hot dip galvanized parts, should be considered.

To achieve a specific clamp force and a consistent torque/clamp force relationship for fasteners with ISO metric thread, at least one of the mating threaded fasteners should be lubricated. Zinc flake coating systems provide lubricated solutions (see section 4.1 of this document). Torque/clamp force relationship can be determined in accordance with ISO 16047 and expressed as a coefficient of friction μ (or by K-factor).

3.2.2 Other properties of the assembly with coated fasteners

3.2.2.1 Chemical resistance

Organic top coats applied on zinc flake base coats are more resistant to acidic and alkaline chemicals than inorganic top coats.

3.2.2.2 Electrical conductivity

The electrical conductivity of metallic zinc & Aluminium flake base coats with inorganic top coat is generally suitable for application of electrophoretic coatings and antistatic purposes. Metallic zinc & Aluminium flake coating systems are not suitable for electrical grounding.

3.2.2.3 Cleanliness

For cleanliness requirements, the suitability of the zinc flake coating system should be checked (e.g. dust, particle size, particle type, number of particles).

3.3 Mechanical and physical properties and curing

The coating process shall not adversely influence the mechanical and physical properties of the fasteners.

Depending on the metallic zinc & Aluminium flake coating system, the curing temperatures can be up to 320 °C. The curing temperature shall not be above the tempering temperature of quenched and tempered fasteners.

WARNING: The curing process (especially with higher temperature and/or longer duration) may affect the fatigue limit of fasteners with thread rolled after heat treatment. Curing process (especially with higher temperature and/or longer duration) may have an effect on the properties/performances of fasteners:

- When the curing temperature is above the tempering temperature, reduction of hardness may affect the performances of case hardened or nitro carburised fasteners (e.g. for thread forming screws), or elastic and plastic deformation (e.g. for clips);
- For cold worked fasteners or fasteners with thread rolled after heat treatment, residual stresses may be reduced.

3.4 Avoidance of internal hydrogen embrittlement

A characteristic of metallic zinc & Aluminium flake coating systems is that hydrogen is not generated during the deposition process.

Pre-treatment processes using alkaline/solvent cleaner followed by mechanical cleaning do not generate hydrogen, thus eliminating all risk of internal hydrogen embrittlement (IHE).

Cathodic cleaning processes are not permitted.

NOTE: Metallic Zinc & Aluminum flake coatings have a high permeability for hydrogen which, during the curing process, allows outward diffusion of hydrogen which may have been absorbed during the pre-treatment process as specified in this sub clause.

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4.0 Metallic Zinc & Aluminium flake coating systems and coating processes

4.1 Coating systems:

There are four basic metallic Zinc & Aluminum flake coating systems as shown in Figure 1.

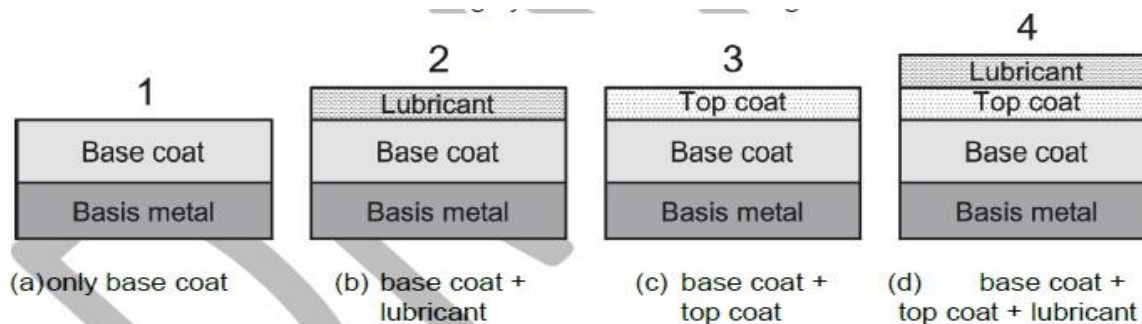


Figure 1 – Basic zinc flake coating systems

Base coat and top coat can be with integral lubricant, see detailed possible combinations in Figure 2 below.

An integral lubricant may be chosen to achieve torque/tension properties. An additional top coat may be chosen to increase corrosion resistance and to achieve other specific properties (e.g. torque/tension properties, resistance to chemicals, mechanical resistance, aspect, colour, thermal resistance, electrical insulation/conductivity, UV resistance). The selection of the nature of the top coat should be based on desired additional properties (i.e. Organic top coat: electrical insulation, high resistance to chemicals or colouring possibilities, etc. and Inorganic top coat: impact/abrasion resistance or thermal resistance, etc.). An additional lubricant may be chosen to adjust torque/tension relationship.

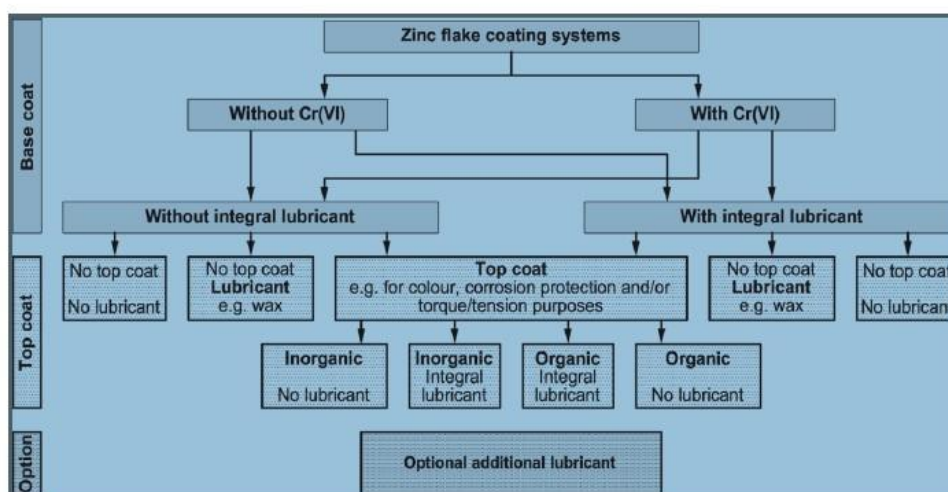


Figure 2 – Typical zinc flake coating systems

4.2 Coating process

Metallic zinc & Aluminium flake coating systems can be applied in rack process using dip-spin or spray process.

Metallic zinc & Aluminum Zinc flake coating is generally a mass process. When lots of small quantity have to be coated, a suitable coating line and/or process may be necessary in order to

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achieve the required properties and performances for the coated fasteners. For fasteners of large size or mass or when the risk of thread damage has to be reduced, rack instead of bulk process may be considered.

5.0 Dimensional requirements and its testing

5.1 General

Before coating, fasteners shall be within the specified dimensions. For ISO metric threads special requirements may apply, (For details see 5.2 below).

5.2 Bolts, screws, studs and nuts with ISO metric threads

5.2.1 Coating thickness

When considering the coating thickness related to the desired corrosion resistance, the dispersion of the thickness of the coating system shall be taken into account.

Coating thickness has a significant influence on gaugeability, therefore thread tolerance and clearance in the thread shall be taken into account. The coating shall not cause the zero line (basic size) to be exceeded in the case of external threads; nor shall it fall below in the case of internal threads.

NOTE: For standard bolts, screws, studs and nuts not specifically manufactured to accommodate metallic Zinc & Aluminium flake coatings.

5.2.2 Gaugeability and Assemblability

Coated ISO metric screw threads shall be gauged in accordance with ISO 1502 with a GO-gauge of tolerance position h for external threads and H for internal threads.

When gauging a coated external thread, a maximum torque of $0.001 d^3$ (Nm) is acceptable, where d is the nominal thread diameter in millimetres, see Table 1 below.

Table 1 – Maximum torque for gauging of coated ISO metric screw threads

Nominal thread diameter, d mm	Maximum torque for gauging ^a Nm
4	0.06
5	0.13
6	0.22
8	0.51
10	1.0
12	1.7
14	2.7
16	4.1
18	5.8
20	8.0
22	11
24	14
27	20
30	27
33	36
36	47
39	59

^a For other diameters, the torque shall be calculated in accordance with $0.001 d^3$ (Nm) and rounded to 2 digits.

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Acceptance procedures for assemblability may be applied by agreement between supplier and purchaser:

- For external thread, use of a suitable nut or the original mating fastener;
- For internal thread, use of a suitable mandrel (e.g. the mandrel specified for proof load in accordance with ISO 898-2) or the original mating fastener.

6.0 Mechanical and physical properties and testing

6.1 Appearance

The colour of a metallic Zinc & Aluminium flake coating is originally silver-grey. Other colours can be obtained by using a top coat. Variation in colour shall not be cause of rejection unless otherwise agreed.

The coated fastener shall be free from blisters and uncoated areas which can adversely affect the corrosion protection. Local excess of coating shall not impair functional properties (see Clause 5 and 3.2 of this document).

6.2 Corrosion resistance related to temperature

Elevated temperature can affect the corrosion protection of the coated fasteners. This test is specified for in-process control; it is not intended to check the behaviour of the coated fasteners together with the assembled parts.

After heating the coated fasteners for 3 h at 150 °C (part temperature) the corrosion resistance requirements as specified in Clause 7 of this document shall still be met.

6.3 Test methods for thickness or coating weight determination

Coating thickness or coating weight shall be determined using one of the following test methods:

- Magnetic inductive techniques (determination of the total local thickness, on measuring areas);
- X-ray techniques (this method is only capable to determine the local thickness of the base coat, on measuring areas);
- Chemical or mechanical removal of the coating system (determination of the average total coating weight of the fastener);
- Microscopic method in accordance with ISO 1463 (determination of the total local thickness, on any area(s) of the fastener).

In case of dispute, the microscopic method in accordance with ISO 1463 shall be used. The thickness shall be measured on the reference areas specified in Figure 3 below, unless otherwise agreed.

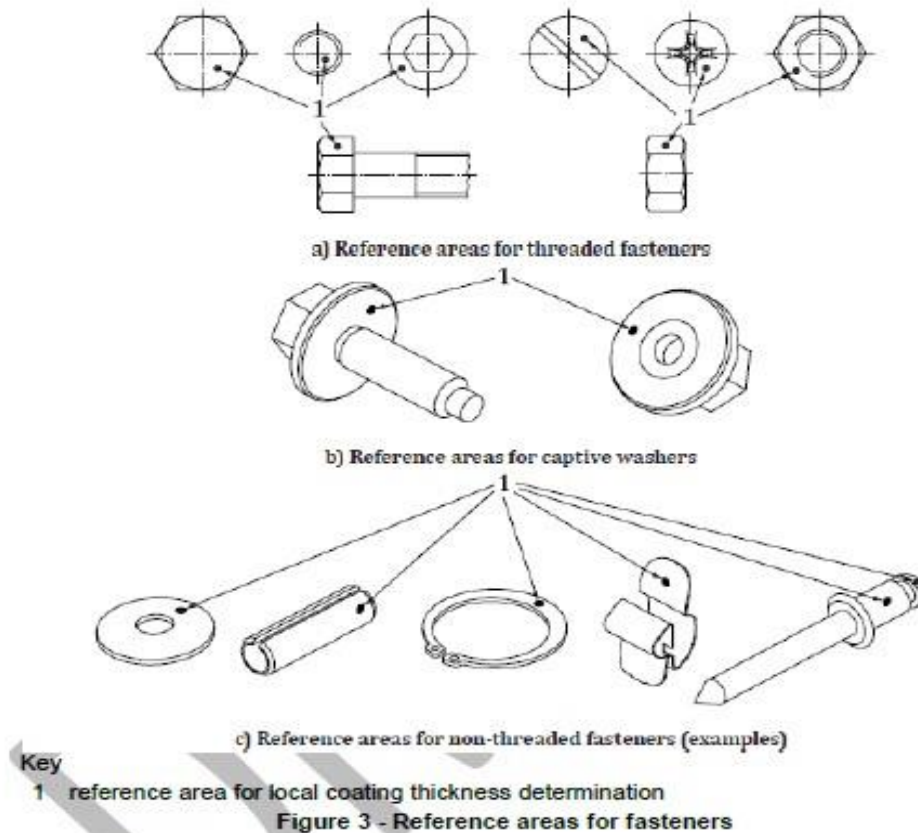
6.4 Ductility

Metallic Zinc & Aluminum flake coating systems are generally not very ductile, i.e. corrosion performance can be affected when deformation occurs after coating. Ductility shall be compatible with the elastic deformation occurring during assembly of the fastener, e.g. tightening of threaded fasteners, flattening for conical washers, bending for clips during installation.

The ability of the metallic Zinc & Aluminum flake coating system to deform should not cause impairment of the performance of the fastener, e.g. corrosion resistance, torque/clamp force relationship when specified. Therefore, suitable tests for particular applications shall be agreed between the purchaser and the supplier.

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NOTE: Lack of ductility can generate cracks/chips of the coating thus impairing corrosion resistance.



6.5 Adhesion/cohesion

This test may be carried out at each step of the application process.

When an adhesive tape with 25 mm width with an adhesive strength of (7 ± 1) N is firmly pressed by hand on to the surface and is subsequently pulled off rapidly and perpendicularly to the surface, the coating shall not be peeled off the basis metal. Small amounts of the coating material left sticking to the tape are acceptable.

NOTE: Coating material visible on both surfaces of the fastener and adhesive tape usually results from lack of cohesion. Visible basis metal and coating material on the adhesive tape usually result from lack of adhesion.

6.6 Sacrificial cathodic protection

The sacrificial cathodic protection ability of the coating may be tested as follows:

The fastener shall be scratched down to the basis metal, using a tool with a nominal width of 0.5 mm. After a neutral salt spray test of 72 h duration in accordance with Clause 7 of this document, there shall be no red rust in the scratched area.

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6.7 Torque/clamp force relationship

When specified, the torque/clamp force relationship may be determined for fasteners with external ISO metric thread and nuts with metallic Zinc & Aluminum flake coating systems including integral lubricant and/or subsequently added lubricant.

The test method shall be agreed between the supplier and the purchaser, in accordance with ISO 16047 or other relevant technical specifications. The requirements for torque/clamp force relationship shall be agreed between the supplier and the purchaser.

Storage conditions shall not impair the torque/clamp force performance of the coated fasteners. Torque of fasteners is being specified in Maintenance Manual issued by CAMTECH.

6.8 Determination of hexavalent chromium

The presence or absence of Cr(VI) may be determined. In this case, the determination shall be done in accordance with clause 5.5.2 of ISO 3613:2010.

7.0 Corrosion protection and its testing

7.1 General

Corrosion resistance in accelerated corrosion tests cannot be directly related to corrosion protection behaviour in particular service environments. However, accelerated tests are used to evaluate the corrosion resistance of the coating.

7.2 Neutral salt spray test

The neutral salt spray test (NSS) in accordance with ISO 9227 shall be used to evaluate the corrosion resistance of the coating systems.

When evaluation of the cabinet corrosivity is requested, it should be performed in accordance with Annex C of ISO 10683:2018.

The neutral salt spray test shall be carried out on fasteners alone, no sooner than 24 h after coating in the “as-coated” condition, i.e. before sorting, packaging and/or assembling. After the neutral salt spray test using test duration of Table 2 below, there shall be no visible basis metal corrosion (red rust). The contact points of fasteners with a holding fixture shall not be considered in the evaluation of corrosion protection.

NOTE: Guidance for the selection of coating thickness in relation to corrosion protection is given in Annex B of ISO 10683:2018.

7.3 Sulphur dioxide test (Kesternich test)

The sulfur dioxide test with general condensation of moisture in accordance with ISO 6988 shall be used to evaluate the corrosion resistance of the coating systems, the test shall be carried out with two litres of SO₂.

The sulphur dioxide test shall be carried out on fasteners alone, no sooner than 24 h after coating in the “as-coated” condition, i.e. before sorting, packaging and/or assembling.

The minimum number of cycles shall be agreed between the supplier and the purchaser at the time of the order, i.e. 2 cycles, 3, 5, 8, 10, 12, 15 cycles, etc.

The contact points of fasteners with a holding fixture shall not be considered in the evaluation of corrosion protection.

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Table 2 — Standard categories for neutral salt spray test

Neutral salt spray test duration (without red rust)	Reference thickness of the coating system (a)
240 h	4 µm
480 h	5 µm
600 h	6 µm
720 h	8 µm
960 h	10 µm
1000 h	12 µm
a The reference thickness includes base coat(s) and top coat(s) if any, with or without Cr(VI). The corrosion resistance shall be decisive for acceptance; the reference thickness is given for guidance only.	

7.4 Bulk handling, automatic processes such as feeding and/or sorting, storage and transport

Bulk handling, automatic processes such as feeding and/or sorting, storage and transport can cause a significant reduction of corrosion protection depending on the coating system and type and geometry of the fasteners. This can especially occur for Cr(VI)-free coating systems where less self-healing effect takes place and/or where top coats are sensitive to impact damage and/or abrasion.

8.0 Applicability of tests

8.1 General

All requirements specified in para 5, 6 and 7 apply as far as they are general characteristics of the coating or are separately specified by the purchaser.

8.2 Tests mandatory for each lot

The following tests shall be carried out for each lot of fasteners (see ISO 3269).

- Gauging of thread (see 5.2.2).
- Appearance (see 6.1).
- Neutral salt spray test (see 7.0)
- Corrosion resistance: neutral salt spray test (see 7.2) or, alternatively and only when specifically required, sulfur dioxide test (see 7.3). Significant areas may be specified for the evaluation of the corrosion resistance.
- Coating thickness or coating weight (see 6.3).
- Torque/clamp force relationship (see 6.7 and Table 4).
- Ductility (see 6.4).
- Cathodic protection (see 6.6).
- Presence or absence of Cr(VI) (see 6.8).

8.3 Tests for in-process control

The following tests are not intended to be applied for each fastener lot, but shall be used for in-process control (see ISO 16426), when relevant:

- Corrosion resistance: neutral salt spray test (see 7.2) or, alternatively and only when specifically required, sulphur dioxide test (see 7.3).
- Temperature resistance (see 6.2).
- Coating thickness or coating weight (see 6.3).
- Adhesion/cohesion (see 6.5).

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9.0 Designation

9.1 Designation of metallic Zinc & Aluminium flake coating systems for the order

The designation of the coating shall be added to the fastener designation in accordance with the designation system specified in ISO 8991. The metallic Zinc & Aluminium flake coating system shall be designated in accordance with Table 4 below and in the same order. A slash (/) shall be used to separate data fields in the coating designation.

9.2 Designation of zinc flake coating systems for labelling

At least the following information shall be added on the label, separated by a slash (/):

- flZn for the metallic Zinc & Aluminium flake coating (base coat);
- yc for coating with Cr(VI), or nc for Cr(VI) free coating;
- Minimum duration of corrosion resistance (neutral salt spray) in hours.

10.0 Some more issues related to fasteners and coating processes required proper attention of supplier

10.1 General

The type of fasteners should be considered when choosing a coating system and related coating process. Para 10.2 to 10.10 list the main issues for each type of fasteners. 100 % sorting is required for specific characteristic(s). Suitable measures shall be taken into account for the following potential issues.

10.2 Fasteners with ISO metric thread

- Thread damages (the heavier the part, the more sensitive it is).
- Filling of drive/recess.
- Retention of particles in threads.
- For fasteners to be coated and with pitch $P < 1$ mm, a special agreement between supplier and purchaser should be reached.
- Contamination with foreign parts.

10.3 Fasteners with captive washers

- Retention of particles (e.g. when shot blasting is used).
- Free rotation of the washer.
- Contamination with foreign parts.

10.4 Fasteners with adhesive or patch

Applicability on metallic Zinc & Aluminium flake coating systems and functional properties should be evaluated.

10.5 Nuts

- Retention of particles in threads.
- For fasteners to be coated and with pitch $P < 1$ mm, a special agreement between supplier and purchaser should be reached.
- Contamination with foreign parts.

10.6 Prevailing torque nuts

For all metal prevailing torque nuts, metallic Zinc & Aluminium flake coating systems in combination with silicate based top coat may cause scratching of the coating, fouling or even galling during tightening. In this case, an alternative top coat or additional lubricant should be used.

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For prevailing torque nuts with non-metallic insert, the effect of the curing temperature should be considered.

10.7 Fasteners with recess, internal drive or cavities

Special techniques can be necessary to prevent retention of particles (e.g. when shot blasting is used as pre-treatment) and excess of coating in recesses or internal drives or cavities.

10.8 Screws which form their own mating threads

When selecting metallic Zinc & Aluminium flake coating systems, the requirements for thread-forming properties should be considered.

NOTE: It includes thread forming and thread cutting screws, tapping screws, drilling screws, chip board screws, screws for plastics and similar fasteners.

10.9 Clips and retaining rings

Plastic deformation and tangling of clips and retaining rings should be avoided during the coating process.

Special techniques can be necessary to prevent excess of coating in retention zones.

10.10 Storage of coated fasteners

During storage and before installation, direct contact with water or other liquid, condensation, exposure to dust, etc. should be avoided; such conditions can impair torque/clamp force relationship and/or corrosion resistance.

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ANNEXURE-II**FASTENER LIST IS FOR REFERENCE ONLY AND MAY CHANGE LATER ON**
High Tensile fastener for critical application in VB coaches

SN	Description of fasteners	Size of Fasteners	Specified torque (N)
1	Bolt	M22x110	744
	Bolt	M16x120	279
	Bolt	M16x80	248
	Bolt	M16x50	279
	Bolt	M16x45	279
	Bolt	M16x80	190
	Bolt	M20x80	157
	Bolt	M20x65	157
	Bolt	M16x60	188
	Bump stop	M12x40	40
	Bolt	M20x65	546
	Bolt	M14x60	180
	Bolt	M14x80	180
	Bolt	M8x20	23.0
	Bolt	M20x130	546
	Bolt	M12x50	77
	Bolt	M12x55	77
	Bolt	M12x55	77
	Bolt	M12x50	77
	Bolt	M16x60	190
	Bolt	M16x130	190
	Bolt	M16x70	168
	Bolt	M12x100*	60
		M12x100	
	Bolt	M24x120	938
	Bolt	M16x80	232
	Side bumper	M16x60	190
	Bolt	M16x100	279
	Bolt	M16x150	279
	Serrated Washer	Dia. 16	min. 400HV
	Plain Nut	M16 - 10	
	Serrated Washer	Dia. 24	min. 400HV
	Plain Nut	M24 – 8	
	Serrated Washer	Dia. 20	min. 400HV
	Plain Nut	M20 – 10	
	Plain Nut	M24 – 10	
	Serrated Washer	Dia. 22	min. 400HV
	Plain Nut	M22 – 10	
	Plain Nut	M16 - 8	
	Serrated Washer	Dia. 22	min. 400HV
	Plain Nut	M12 – 8	
	Serrated Washer	Dia. 14	min. 400HV
	Plain Nut	M14 – 10	
	Serrated Washer	Dia. 8	min. 400HV
	Serrated Washer	Dia. 12	min. 400HV

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	Plain Washer	M16	300HV
	Prevailing Torque Nut	M16 – 10	
	Bolt	M24x190	
	Plain Washer	M24 – 200HV	
	Prevailing Torque Nut	M24 – 8	
	Plain Washer	M20 – 300HV	
	Prevailing Torque Nut	M20 – 10	
	Bolt	M20x140	
	Plain Washer	M20 – 300HV	
	Prevailing Torque Nut	M20 – 10	
	Bolt	M24x90	
	Plain Washer	M24 – 300HV	
	Prevailing Torque Nut	M24 – 10	
	Bolt	M22x140	
	Plain Washer	M22 – 300HV	
	Prevailing Torque Nut	M22 – 10	
	Bolt	M22x110	
	Plain Washer	M16 – 200HV	
	Prevailing Torque Nut	M16 – 8	
			Washer, t=1.5mm, C45, no paint on both contact sides, Page-45
	Plain Washer	M14 – 300HV	
	Plain Washer	M12 – 200HV	
	Bolt	M16x60	
	Nord lock washer	NL 16, min. 400HV	
	Nord lock washer	NL12 – min. 400HV	
	Nord lock washer	NL20 – min. 400HV	
	Nord lock washer	NL14 – min. 400HV	
	Nord lock washer	NL8 – min. 400HV	
	Nord lock washer	NL16sp – min. 400HV	
	Nord lock washer	NL24 – min. 400HV	

* Length of bolt have to be relevant due to length of shank and thickness of all clamped parts or nonstandard, fully threaded one needs to be used.

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High Tensile Fasteners used in FIAT Bogie

S. N	FIAT Bogie	Fastener Description	Size	Drawing / Specification	Specified torque (N)	Remarks
1.	CTRB	Hex HD Screw for CTRB	M20x60	RDSO CG-15067	200Nm	Ref. Drg. No. 1268823, Item No. 6
2.		Hex HD Bolt for Phonic wheel of CTRB	M8x35	RDSO CG-15071	30Nm	Ref. RDSO Instructions
3.		Hex HD Screw for earthing device of CTRB	M8x30	RDSO CG-15070		
4.	Bogie	HEX HD BOLT	M16X70	IS:1364-2002, PT-I, IS:1367-2002, PT-3, 10.9, CE, MDTS-057	170Nm	Ref. Drg. No. 1268732, Item No. 13
5.		HEX HD BOLT	M16X90		170Nm	Ref. Drg. No. 1268732, Item No. 14
6.		HEX HD BOLT	M20X100		265Nm	Ref. Drg. No. 1268732, Item No. 15
7.		HEX HD BOLT	M24X150		590Nm	Ref. Drg. No. LE05105, Item No. 38
8.		HEX HD BOLT	M24X200		590Nm	Ref. Drg. No. LE05105, Item No. 39
9.		HEX HD BOLT	M12X55		70Nm	Ref. Drg. No. LE05105, Item No. 51
10.		HEX HD BOLT	M12X100		70Nm	Ref. Drg. No. LE05105, Item No. 54
11.		HEX HD BOLT	M12X70		70Nm	Ref. Drg. No. LE05105, Item No. 55
12.		HEX HD BOLT	M16X65		170Nm	Ref. Drg. No. LE05105, Item No. 29
13.		HEX HD BOLT	M16X170		170Nm	Ref. Drg. No. LE05105, Item No. 48
14.		HEX HD BOLT	M20X120		340Nm	Ref. Drg. No. LE05105, Item No. 33
15.		HEX HD SCREW	M16X120		170Nm	Ref. Drg. No. LE05105, Item No. 44
16.		HEX HD SCREW	M16X100		170Nm	Ref. Drg. No. LE05105, Item No. 46
17.		HEX HD SCREW	M16X45		170Nm	Ref. Drg. No. 1268823, Item No. 7
18.		HEX HD SCREW	M16X60		170Nm	Ref. Drg. No. 1268820, Item No. 3
19.		HEX HD SCREW	M10X25	DIN 6925/DIN980V, IS:1367-2002, PT-8, 10, A3B	40Nm	Ref. Drg. No. 1268699, Item No. 4 & 5
20.		HEX HD SCREW	M10X16			
21.		HEX HD SCREW	M24X100		590Nm	Ref. Drg. No. 1267422, Item No. 13
22.		HEX HD SCREW	M10X30		Torque not specified in Drg	Drg. No. LW36004, Item No. 8.
23.		HEX HD SCREW	M16X50		170Nm	Ref. Drg. No. 1268821, Item No. 6
24.		HEX NUT PREVAILING TORQUE TYPE	M8			
25.		HEX NUT PREVAILING TORQUE TYPE	M10			
26.		HEX NUT PREVAILING TORQUE TYPE	M12			
27.		HEX NUT PREVAILING TORQUE TYPE	M16			

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28.		HEX NUT PREVAILING TORQUE TYPE	M20			
29.		HEX NUT PREVAILING TORQUE TYPE	M24			
30.		HEX NUT	M30	IS:1364-2002, PT-3, IS:1367-2002, PT-6, 10, CE, MDTs-057	250Nm	Ref. Drg. No. LE05105, Item No. 26
31.		HEX SOCKET HD CAP SCREW	M12X45	IS:2269-2006, IS:1367-2002, PT-3, 10.9, CE, MDTs-057	70Nm	Ref. Drg. No. LE05105, Item No. 40
32.		HEX SOCKET HD CAP SCREW	M8X25		Torque not specified in Drg.	Drg. No. 1268823, Item No. 14
33.		HEX SOCKET HD CAP SCREW	M12X60		Torque not specified in Drg.	Drg. No. LW05001, Item No. 59,
34.		HEX SOCKET HD SCREW WITH FLAT POINT	M12X25-45H	IS:6094-2006, PT-1 ISO 898, PT-5, MDTs-057	Torque not specified in Drg.	Drg. No. LW05001, Item No. 60
35.		HEX SOCKET COUNTER SUNK HD SCREW	M8X70	IS:6761-1994, 12.9, MDTs-057	Torque not specified in Drg.	Drg. No. LW05001, Item No. 54
36.		HEX HD PLUG SCREW	M22X1.5	DIN 910, ST, IS:1367-2002, PT-3, 10.9, A3C	Torque not specified in Drg.	Drg. No. 1268823, Item No. 13
37.		HEX HD PLUG SCREW	M10X1	DIN 910-St, IS:1367-02, PT-3, 10.9 A3C	Torque not specified in Drg.	Drg. No. 1267422, Item No. 11&10
38.		HEX HD PLUG SCREW	M27X2	DIN 910-St, IS:1367-02, PT-3, 10.9, A3C		
39.		HEX SOCKET HD CAP SCREW	M20X55	IS:2269, IS:1367-2002, PT-3,	340Nm	Ref. Drg. No. LE05105, Item No. 56 Being procured with air spring

FINAL

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