

SECTION 8-5: RAIL FASTENER SYSTEM

PART I DESCRIPTION

1 . Scope

The qualification and provision of an elastic rail fastener system and resilient fastening systems, The system shall provide lateral, longitudinal and vertical support to rails against imposed forces through the use of a spring steel bar in torsion and bending and with insulation against the shorting of track circuits.

The elastic fastening shall be useable in ballasted track and the resilient fastening in the ballastless track. The system shall be useable with all concrete sleepers and bearers in plain line and in turnouts. Only fastener system "Pandrol", "Vossloh" and "Stedef" or "equivalent" can be used in this project.

The resilient fastening shall be in the form of resilient baseplates, as described in the Specifications.

Work Includes: Clips, shoulders, baseplates, insulators, rail pads and other assembly components of the fastening system.

Work Not Included: Installation. Testing of assembled track fastenings. Fastener system on steel bridge.

2 . Definitions

"Clip" - A spring steel device with the function of holding the rail upright against the outward forces applied by the wheel flanges and to fix the rail longitudinally.

"Fastener" - The device fastening the rail to the sleeper.

"Insert" - Also termed "Shoulder" Male insert embedded in the sleeper for attaching the fasteners to the sleeper.

"Insulator" - Insulating material to prevent electrical contact between foot of the rail and any clip holding down the rail and between the rail and any metallic components embedded in or attached to a sleeper.

"Rail Pad" - The rail pad is placed on the Rail Seat Area to cushion the effect of vertical loads and to act as a longitudinal spring for the distribution of longitudinal forces acting on the rail.

"Rail Seat Area" - Flat surface of a sleeper to receive the rail base and pad.

"Set" - All the fastener components required for one sleeper.

"Sleeper" - A sleeper transmits the wheel loads to the ballast and holds the rail to gauge and to the required inclination.

3 . Quality Assurance

- 3.1 Manufacturers or Contractors who intend to use rail fastening system other than "Pandrol", "Vossloh" and "Stedef" for this project are required to submit test report as required in PART III EXECUTION 1. **Acceptance** Procedure for approval.

All tests shall be performed by Testing Agency in Thailand. Where no testing equipment is provided in Thailand, such test shall be performed by Independent Testing Agency in a third country upon approval by SRT.

Test results of SRT's past project may be used in case that such test conform to requirements of this Specification

- 3.2 In addition to the requirements of SECTION 1-10 - QUALITY ASSURANCE AND TESTING LABORATORY the Contractor shall maintain adequate records in accordance with the requirements of his quality assurance programme.

The manufacture is expected to operate an independently approved and audited quality control system in accordance with the requirements of ISO 9000. Where the rail fastening system manufacturer cannot produce such independent certification the following requirements shall apply.

- (a) The Contractor shall submit the Inspection Agency's name to the Engineer for approval prior to the commencement of manufacture.
 - (b) The Contractor shall provide the Inspection Agency with reasonable access to observe manufacturing process, witness testing and to inspect the finished product.
 - (c) The Contractor shall, at his own expense, supply all templates and gauges, prepare and supply all test pieces and samples and supply all labour and apparatus for testing which may be necessary or required for carrying out the tests and requirements of this specification, and render all reasonable assistance in making such tests. The Contractor shall also, at his own expense, supply all drillings, test pieces and samples for carrying out independent chemical analysis and tests.
 - (d) Before the fastening components are submitted to inspection regarding surface, shape and finish, all components shall be properly examined by the Contractor's inspectors and all defective fastening components removed and placed in separate stacks and the rest sorted for examination by the Inspection Agency.
 - (e) Some special tests may be conducted by a recognized laboratory as directed by the Engineer, all expenses and costs shall be borne by the Contractor.
- 3.2 The rail fastening system to be used in this Contract shall be a proven product with at least 100 track kms for five years in at least five railway administrations.
- 3.3 Components shall be the product of the Original Manufacturer of the Rail Fastening System. The products of licensees shall only be accepted when the Original Manufacturer has established and operates an approved Quality Control Programme at the place of manufacture used for this Contract.
- 3.4 Components shall be manufactured by a proper technological process to achieve a high quality for properties of materials, dimensions and tolerances, loading performance and resistance to atmospheric factors and fatigue all to be in compliance with the Drawings and the requirements of this specification.
- 3.5 The Contractor shall submit to the Engineer a programme for the quality control of the materials used in the fastener components. The programme shall include the ranges of acceptable values where required.

- (a) Clips

The quality control for the clips will include, but not necessarily be limited to:

- Characteristics of the steel before manufacturing.
- Geometry of the clip according to the drawings of the accepted design.
- Micrography and microscopy of the material before and after manufacture.

- Standard test on the steel after manufacturing: hardness; strength; distortion at breaking stress; and breaking stress.
- Fatigue test
 - Test of minimum elasticity without distortion beyond the elastic limit after five deflections equivalent to the distortions to be incurred in a track laying operation.
- Corrosion protection.
- Corrosion test.

(b) Insert - Metal

Threaded components will be permitted only if a part of the insert system.

- Physical, metallurgical and mechanical tests necessary to verify the capability of the insert to function in the system.
- Protection against corrosion and a corrosion test shall be defined by a recognized standard.
- No noticeable corrosion (defined by a standard) shall occur after a salt spray test.

Insert - Non metallic.

Threaded components will be permitted only if a part of the insert system.

A material either of rubber or thermoplastic, defined by its physical, electrical and chemical properties

- strength and other physical properties
- control of shape,
- verification of the raw material,
- aging test after manufacturing process,
- specific tests to verify the compliance with the general performance of the fastening system¹ and its environment including exposure to hydrocarbons.

(c) Clip Shoulders

The quality control for the clip shoulders will include, but not necessarily be limited to:

- Characteristics of the steel before manufacturing.
- Geometry of the clip shoulder according to the drawings of the accepted design.
- Micrography and microscopy of the material before and after manufacture.
- Standard test on the steel after manufacturing: hardness; strength; distortion at breaking stress; and breaking stress.
- Fatigue test.

(d) Insulator

A material, normally thermoplastic, defined by its physical, electrical and chemical properties.

- Control of shape.
- Verification of the raw material.

- ageing test after manufacturing process,
- Specific tests to verify the compliance of the insulator with the general performance of the fastening system and its environment including exposure to hydrocarbons.

(e) Pad

The mechanical physical, chemical, and ageing tests necessary to ensure the specific qualities of the product shall be carried out.

The quality control programme shall include shape control and a test to verify the compliance with the spring rate.

The ratio between total deflection/total thickness unloaded must be 15%.

The following minimum properties shall be defined:

- Breaking stress.
- Breaking stress after ageing.
- Distortion at the breaking stress.
- Distortion at the breaking stress, after ageing.
- Abrasion.
- Permanent distortion after ageing (24 hours - 100°C and 50% distortion)

Ageing is generally 4 days/100°C in a steam room.

These tests may be carried out on samples cut from the pads.

4. Tolerances

Dimensional tolerances shall not exceed the tolerances shown on the Manufacturer's drawings.

5. Submittals

The Supplier shall submit to the Engineer in accordance with SECTION 1-4 - SUBMITTALS AND SUBSTITUTIONS for approval the following:

- (a) Certificate for proven record of use in other railway administrations.
- (b) Name and address of Manufacturers supplying each component.
- (c) Copies of all material and production test results.
- (d) Three samples of each component for use as a standard to which all products shall correspond.
- (e) Certificates of Inspection.
- (f) Manufacturer's Certificate of Compliance with the requirements of this Specification.

6. Delivery, Storage and Handling

6.1 Delivery

Fastenings, baseplates and appurtenances shall be delivered in manufacturer's original unopened packaging to both concrete sleeper manufacturer and to the Contractor's Site Depot.

6.2 Storage

All components shall be stored off the ground, under cover and out of direct sunlight.

6.3 Handling

- (a) Metal Components: Packaged in strong wooden boxes. Each box shall weigh less than 100 kg.
- (b) Pads and Insulators: Packaged in strong wooden or cardboard boxes. Each box shall weigh less than 100 kg.

PART II: PRODUCTS

1. General

The Engineer will approve elastic rail fastening system and resilient fastening system that satisfies the requirements of this specification and SECTION 8-6 - TESTING OF ASSEMBLED CONCRETE SLEEPERS subject to the requirements of SECTION 1-2 - APPLICABLE STANDARDS, The complete fastening system when assembled shall be located in and above the top surface of the sleeper. Threaded components will only be permitted when they are part of the insert embedded in the sleeper.

Acceptance of the fasteners requires the performance of three stages of qualification; the design qualification; the performance tests; and production testing.

System performance requires the following mechanical characteristics:

- Clip deflection on clamping 11 mm \pm 1.5 mm.
- Clamping force per rail seat 20 - 24kN.
- Rail Creep resistance per rail seat: 13 - 22kN with proposed rail pad.
- Electrical resistance > 20K Ohms.
- When used on turnouts the system shall be proven of withstanding upward loads from mechanized on track switch maintenance equipment.

2. Marking

Clips and Pads shall be marked, and packages containing components will be identified with the following information:

- (a) Type of component.
- (b) Date of manufacture and/or packaging.
- (c) Number c products per package.
- (d) Gross weight of package.

Pads shall be marked on the top of one edge of each pad with the following ribbed letters:

- (a) SRT.
- (b) Fastener Trade Name.
- (c) 54E1.
- (d) Year of manufacture.

No marking is made on inserts, clips or insulators.

3. Spring Clips

3.1 Design

The spring clip shall obtain its toe load force by the combination of torsion and bending. Clips relying on bending only shall be unacceptable.

The spring clips shall be specifically designed to prevent illegal removal of the clip from its housing without the use of a special tool.

The steel shall be an alloy spring steel free from detrimental surface and internal defects.

Chemical Composition: The steel shall be a silicon manganese steel with a chemical composition that complies with Table 8-5.1., or a recognized **International** or UIC standard.

Table 8-5.1 Spring Clip Composition

Either (i)	Min	Max	Or (ii)	Min	Max
C	0.52	0.57	C	0.52	0.60
Si	1.7	2.1	Si	1.5	2.0
Mn	0.8	2.1	Mn	0.60	0.90
Cr	0.2	0.3	P		0.035
Mo	0.01	0.06	S		0.035
Ni		0.30	Cr		0.30
Cu		0.035			
Sn		0.035			
S		0.035			
P		0.035			

- 3.2 Hardness: The clips shall be heat treated to achieve a surface hardness in the range 44 - 48 Rockwell C or 385 - 425 Brinell Hardness Number

3.3 Workmanship

- (a) The rail clips shall conform to the dimensions detailed by the proprietor of the system.
- (b) Clips shall be supplied free of burrs which may be considered harmful when handled or affect efficient assembly of the clip.
- (c) Clips shall be provided in standard bituminous or oil coating.

4 . Inserts

Threaded components will only be permitted as part of the insert sub-system. The material shall conform to the proprietor's design requirements regarding the physical properties and dimensions detailed on the appropriate manufacturer's drawing.

The insert shall be fully compatible with the threaded components, and the insert, if rubber or thermoplastic, shall be fully replaceable without coring out the old insert and grouting in a replacement.

5 . Clip Shoulders

5.1 Material

The material will be a pearlitic malleable iron or a spheroidal graphite iron to BS 3333 or BS 278 respectively with the mechanical properties as detailed below:

- (a) Tensile Strength (minimum)
Pearlitic Malleable: 510N/mm²
Spheroidal Graphite: 500N/m²
- (b) 0.5%Proof Stress(minimum)
Pearlitic Malleable: 310N/mm²
- (c) 0.2% Proof Stress (minimum)
Spheroidal Graphite: 320N/mm²
- (d) Elongation (minimum)
Pearlitic Malleable: 4%
Spheroidal Graphite: 7%
- (e) Hardness Range
Pearlitic Malleable: 170 - 220Brinell
SpheroidalGraphite: 170 - 245Brinell

5.2 Workmanship

- (a) The cast shoulders shall conform to the dimensions detailed on the appropriate manufacturer's drawing.
- (b) The casting shall be well dressed and fettled, and free from burned or sand cavities, blow holes, or other visual surface defects.
- (c) All fins shall be removed from castings except that:
 - maximum fin height of 0.8 m will be allowed on the casting at the mould join line where this is above the level of the concrete.
 - maximum fin height of 2mm will be allowed on those casting portions which are to be below the concrete level.

- (d) Casting must be free from cracks or tears revealed by magnetic or equivalent non-destructive crack testing. Cracks or tears to a depth of 0.5mm in the general body of the casting may be removed by grinding to the full depth of the crack. Defects within the riser or the casting may be removed by grinding to the full depth of the riser.

6. Rail Insulators

6.1 Material

- (a) The material shall be nylon 66 with 30% to 35% glass fibre reinforcement. An additional ultra violet stabilizing agent shall be added to the raw material. A maximum of 10% clean reground insulator sprues may be added to the virgin raw material. The sprues are to be ground when still hot.
- (b) The raw material shall have the following properties:
- Density - Test method DIN 5347 or ASTM 792
1.2 - 1.45 g/cm³
 - Melt point - Test method ASTM 78
250 - 270 °C
 - Electrical Volume Resistivity - Test method ASTM 257
As moulded: min 10 - 12 ohm cm.
 - Conditioned as below: min 107 ohm cm.
- Water Absorption (Conditioning)
- (c) All insulators shall be conditioned in water at a minimum of 95°C until they have absorbed 0.8 -1.2% of water by weight above their original "as moulded" weight.
- (d) Conditioned samples shall be fixed in a rigid clamp and a test load shall be applied. A minimum load of 450kg shall be applied to the insulator without failure occurring.
- (e) Conditioned samples shall be hardness tested using Rockwell Scale C to test method ASTM 785 procedure A. The average of two readings shall be taken. Visual rolling faults such as cracks, laminations, overlappings and other surface imperfections shall be determined with a microscope.

7. Pads

7.1 Material

Pads shall be a high density polyethylene (HDPE), ethyl vinyl acetate (EVA) or other products complying with UIC 864-5-0, or rubber pad, coloured black with the following properties:

- (a) Carbon content for ultra-violet stabilisation.
- (b) Melt flow index (MFI), using a 5kg load at a temperature of 190°C shall not be greater than 2g/10 minute.
- (c) Density 0.95g/cc nominal.
- (d) Only virgin material shall be used with the exception that material from runners, sprues and rejects may be ground and reused provided that it is thoroughly mixed with the virgin material and the reground material does not exceed 25 percent of the total material by weight.

7.2 Workmanship

- (a) The pads shall be injection moulded in accordance with the general rules of plastic moulding technology.
- (b) Moulding shall be free from any flaking, knifing, overlapping and flow marks, which could weaken the mechanical properties of the pads.

8. Baseplates

8.1 Shall be an Iron Casting that conforms to the requirements of BS310-1972 or BS2789-1985.

8.2 Workmanship

- (a) The cast baseplates shall conform to dimensions shown on the proprietor's drawings.
- (b) In addition to carrying the appropriate manufacturers mark each casting shall be marked SRT and 54E1, and with the last two digits of the year of manufacture.
- (c) Castings shall be free of burned-on sand, cavities, blow holes or other defects visible on the surface. No fins are allowed on the rail seat or on the underside of the baseplates. Materials, cast material, and finished baseplates shall be tested on a sample basis as determined by an approved standard as provided in SECTION 1-2 -APPLICABLE STANDARDS.

9. Coach Screws

9.1 Coach Screws or screwspikes shall be for securing baseplates to timber sleepers and shall be as recommended by the fastening manufacturer.

9.2 Single coil spring washers shall be employed between screwhead and baseplate.

10. Resilient Baseplate

10.1 The resilient baseplates shall be provided between the rail and concrete slab in the ballastless track. The elastomer shall be provided within the baseplate structure. The maximum "footprint" size of the resilient baseplates shall not exceed 200mmx550mm

10.2 The baseplates shall consist of either a bonded baseplate, whereby top and bottom plates are separated by an annular resilient insert bonded to each plate or preassembled resiliently mounted assembly where the plate is separate from the concrete by a natural rubber pad. The resilient baseplate pads shall be manufactured in accordance with UIC 864-5 and the manufacturer's approved specification and shall be tested in accordance with SECTION 8-6.

10.3 The plates shall provide vertical adjustment of 20mm and horizontal adjustment +/-10mm. The plates shall be suitable for installation in plain track.

10.4 The baseplates shall consist of two separated castings which shall be referred to as top and bottom plates. The top and bottom plates shall be separated by a resilient insert that may be fully bonded to each plate.

10.5 The plate shall be of spheroidal graphite malleable cast iron to EN1563 Grade EN-GJS-500-7

10.6 The top plate shall incorporate elements designed by the manufacturer of the approved elastic clips, high viscosity nylon insulators and a 5mm minimum thickness EVA or HDPE rail pad as shown on the drawings.

10.7 The annual resilient insert or rubber pad used within the baseplate shall be natural rubber or natural rubber blend. It shall be compounded with suitable reinforcing agents, antioxidants,

etc. to provide adequate resistance to frequent repeated loadings and provide adequate impact, abrasion, weathering and ageing properties.

- 10.8 The static vertical stiffness of the baseplate shall be based on conventional track. On conventional track, about half the resilience is provide by the ballast bed and other half by th subgrade. Ideally, the stiffness of the overall track structure should be in the order of 100kN/mm, which is equivalent to a deflection of 1mm under an axle load of 20 tonnes. On the ballastless track, where the rails are fixed down directly, additional resilience shall be added to the system in order to compensate for the absence of ballast. The additional resilience shall be provided adequately by the resilient insert within the resilient baseplate.
- 10.9 In addition to any component testing required by manufacturer, the baseplates and components shall be subject to assembly tests, as described in these specifications. Such testing shall be completed and the results shall be subject to the Engineer's approval before mass production of the baseplates commence.
- 10.10 Testing of component parts of the baseplate shall be carried out in accordance with the manufacturer's recommendation. These component part tests shall be subject to approval.
- 10.11 The baseplates shall be protected from corrosion by dry shot blasting and coating with intex or similar to a minimum dry film thickness of 50 microns. The dry shot blasting process shall be subject to approval of the protection material manufacturer and the Engineer.
- 10.12 The resilient baseplates shall have a satisfactory service proven record and shall have been used by five major railways in similar conditions for at least 5 years.
- 10.13 The baseplates shall be indelibly marked in 10mm minimum raised characters with the following:
- (a) Baseplate designation
 - (b) The last two digit of the year of manufacture.
 - (c) The letters "SRT"
- 10.14 These marking shall be subject to the approval of the Engineer.

11. Bolts

- 11.1 All track bolt and holding down bolts shall be manufacture in accordance with UIC Code 864-2, and shall be sheradized to Class 1 in accordance with BS4921 Table1.
- 11.2 The bolt shall be Grade 8.8 to UIC Code 864-2, unless stated otherwise.

12. Flat Washers

Flat washers shall be black washers; from E to BS4320 zinc electroplated and passivated to BS1706 or shall be hot dip galvanized in accordance with BS729 with coating thickness to BS729 Table 1.

13. Double Coil Spring Washers

- 13.1 Spring washers shall be of the double coil "Fe 6" type manufactured in accordance with UIC Code 864-3
- 13.2 The Spring steel shall be 38 S 7 in accordance with Article 1.1 of UIC Code 864-3
- 13.3 The finished spring washers shall be galvanized in accordance with BS 729 with coating thickness to BS 729 Table 1.

14. Helical Spring Washers

- 14.1 The spring shall be manufactured from oil-tempered spring steel in accordance with DIN 17223 Type FD. The end form of the coil shall be closed end and ground in accordance with BS1726, Part 1, Figure 1.
- 14.2 The Spring shall be manufacture from high quality carbon spring steel to BS5216, BS 1429 or BS 2803.
- 14.3 The Spring shall be sherardize to Class 1 in accordance with BS 4921 Table 1.

15. Conforming Pad

- 15.1 The purpose of conforming pad is to provide adequate bearing contact between the baseplate and the concrete sleeper or bearer. The pad shall be a Low Density Polyethylene (LDPE) and 3mm thick.
- 15.2 Raw Material
 - (a) The raw material shall have the following properties:
 - i) Desity : 0.90-0.95g per cm³. Test Method ASTM D1505
 - ii) Melt Flow Index (MFI) : Using a 2kg load at a temperature of 190C, it shall not be greater than 20-30g/10 minutes. Test Method ASTM D1238
 - (b) The raw material supplier shall submit certification with each batch of raw material conforming that the pad raw material has been supplied against the raw material manufacturers published data sheets
- 15.3 Workmanship
 - (a) The pads shall conform to the dimensions and tolerances as detailed on the relevant drawings
 - (b) The pads surface shall be clean and free from sinking, gassing or burning.

PART III: EXECUTION

1. Acceptance Procedure

The acceptance of the fasteners, resilient baseplates and other items mentioned herein requires the performance of three stages of qualification: the design qualification; the performance tests; and the production tests.

Contractors who intend to locally manufacture the rail fastening system for use on this project are required to obtain Thai industrial Standards Institute registration for their products before they will be acceptable to the Engineer.

1.1 Design Qualification

Design qualification consists of two steps.

- (a) Submittal of the fastener design as required herein.
- (b) Successful execution of the design tests.

1.2 Design Tests

The design tests are:

- (a) Clip spring rate.
- (b) Longitudinal creep resistance.
- (c) Torsional resistance in the horizontal plane.
- (d) Horizontal rotation.
- (e) Inclination, gauge retention, and fatigue.
- (f) Pad spring rate.
- (g) Electrical insulation.

1.3 Performance Tests

Acceptance of the fasteners, baseplates and other items produced requires submission of quality control programmes as described herein, and also successful performance of the tests.

The performance and quality control tests are:

- (a) Material quality tests, described in PART II: PRODUCTS.
- (b) Tests of compliance with the whole fastening system as described in SECTION 8-6 - TESTING OF ASSEMBLED CONCRETE SLEEPERS.
- (c) Baseplates assembly tests in accordance with the UIC codes or similar approved by the Engineer.

1.4 Production tests

The production tests require the repetition of the design tests at intervals, as agreed by the Engineer, during production.

2. Certificate of Inspection

- 2.1 The Contractor shall submit Certificates of Inspection of the materials used for manufacture of the fastenings together with all testing and inspection reports of manufacturing quality control of every batch to the Engineer for approval prior to presentation for acceptance of such batches of the fastener components.

All Quality Assurance records of the fastenings supplied shall be kept for a minimum of five years.

- 2.2 The Certificate of Inspection shall include the chemical analysis and other testing reports required in compliance with the specification of the standard referred to.
- 2.3 Upon submission of the rail fastenings to the Inspection Agency for acceptance, the Contractor shall submit a Certificate (or certificates) of Inspection which shall include the report of tests on raw materials used for manufacture of each component, and the report of tests and inspection of manufacturing quality control.
- 2.4 The test procedures may comply with the codes or standard adopted in the country of the manufacturer or other international recognized standards. Such Codes or Standards shall be presented together with the Certificate of Inspection.

3. Acceptance of Clips

- 3.1 Testing

- (a) One clip in four thousand shall be checked for dimensional accuracy. The surface of the clips shall be smooth and free from defects which may cause an injurious or fatigue resistance of the rail fastenings. Bar diameter tolerance shall not exceed $\pm 0.25\%$ on diameter and 0.25mm on maximum ovality. Surface defects shall not have a depth greater than the partial decarburised layer (1.5% of diameter) at that point and shall not at any time exceed 0.25mm.
- (b) One clip in every four thousand clips shall be tested for surface hardness
- (c) One clip in every two thousand clips shall be tested for load deflection. The force exerted by the clip in fastening an assembly shall be determined using a calibrated test rig. The clip assembly with shoulders shall have load deflection characteristic curves which achieve a clamping force of 1800kg \pm 200kg per rail seat at 11 mm deflection.

3.2 Acceptance

- (a) Each production batch shall be accepted if the samples meet the test requirements.
- (b) All test results shall be treated as independently obtained. In the case of a failure the batch shall be re-inspected to the original sampling plan for the failed property only. If further failures result the batch shall be rejected. In the case of dimensional failures, surface defects, cracks and tears or hardness the batch may be 100% inspected and resubmitted for acceptance.

3.3 Re-tests of Clips

- (a) Should the conditions in sub-clauses 3.1 and 3.2 not be met two further tests shall be made on samples selected from the clips represented by the original test.
- (b) Provided the results of both these further tests fulfil the requirements all the clips shall be deemed to comply with this specification.
- (c) If the results of either of the two additional tests do not fulfil the requirements the clips represented shall be rejected.
- (d) The clips rejected for hardness greater than 45 Rockwell C may be retempered and resubmitted for inspection

4. Acceptance of Inserts

4.1 Testing

- (a) Tensile test pieces shall be cast with each batch of inserts from the same batch of material as the inserts they represent. Additional test pieces shall be cast to allow for retests. All test samples shall be subject to the requirements of the relevant material specification.
- (b) Tests pieces shall undergo heat treatment if required, at the same time and in the same furnace as the inserts they represent.
- (c) Tests shall be carried out to confirm the acceptability of the material. All tests shall be as detailed in the relevant material Specifications.
- (d) Physical Test: One tensile test piece will be tested for each cast of material, provided that this does not exceed 2000kg in which case an additional test piece shall be tested from each additional 2000kg or part 2000kg. In the case of a continuous casting process one test piece shall be tested for each four hour period. The results shall comply with requirements.

4.2 Sampling

- (a) A minimum of one in every four thousand inserts shall be inspected with regard to significant dimensions. The inserts shall conform to the dimensions and allowable tolerances detailed in the Drawings.
- (b) For a 50,000 batch size 20 samples shall be taken at random from the batch and the batch shall be rejected if 11 No. or more samples fail to meet the test requirements.
- (c) Surface Irregularities: The surface of the inserts shall be smooth and free from defects which may cause a reduction in fatigue resistance of the rail fastenings. Any occurrence of the surface defect shall not have a depth greater than decarburized layer at that point and shall not at any time exceed 0.30mm. The approved pre-production samples define the surface finish required.
- (d) Cracks and Tears: The castings shall be free from cracks and tears. Inspection shall be by a recognised non-destructive crack testing procedure.
- (e) Hardness: One in every four thousand inserts manufactured in Pearlitic Malleable and one in every three thousand shoulders manufactured in Spheroidal Graphite shall be hardness tested.

4.3 Acceptance

- (a) Each production batch shall be accepted if the samples meet all the test requirements.
- (b) All test results shall be treated as independently obtained. In the case of a failure the batch shall be re-inspected to the original sampling plan for the failed property only. If further failures result the batch shall be rejected. In the case of dimensional failures, surface defects, cracks and tears or hardness the batch may be 100% inspected and resubmitted for acceptance.

4.4 Retests

- (a) Should the physical condition or the tests or any part thereon not be met, two further tests shall be made on samples selected from the inserts represented by the original test.
- (b) Provided the results of both these further tests fulfil the requirements, all the inserts shall be deemed to comply with this specification.
- (c) If the results of either of the two additional tests do not fulfil the requirements, the inserts represented shall be rejected.

5. Acceptance of Clip Shoulders

5.1 Testing

- (a) Tensile test pieces shall be cast with each batch of shoulders from the same batch of metal as the shoulders they represent. Additional test pieces shall be cast to allow for retests. All test samples shall be subject to the requirements of the relevant material specifications.
- (b) Test pieces shall undergo heat treatment, if required, at the same time and in the same furnace as the cast shoulders they represent.
- (c) Tests shall be carried out to confirm the acceptability of the material. All tests shall be as detailed in the relevant material Specifications.
- (d) Physical Test: One tensile test piece will be tested for each cast of metal, provided that each cast does not exceed 2000kg in which case an additional bar shall be tested from each additional 2000kg or part 2000kg. In the case of a continuous casting process one test piece shall be tested for each four hour period. The results shall comply with requirements.

5.2 Sampling

- (a) A minimum of one in every four thousand clip shoulders shall be inspected with regard to significant dimensions. The clip shoulders shall conform to the dimensions and allowable tolerances detailed in the Drawings.
- (b) For a 50,000 batch size 20 samples shall be taken at random from the batch and the batch shall be rejected if 11 No. or more samples fail to meet the test requirements.
- (c) Shoulders shall be inspected to a Normal Single Sample Plan, Inspection Level I, as specified in British Standard 6001, with regard to significant dimensions.
- (d) Surface Irregularities: Shoulders shall be inspected to BS 6001, Normal Single sample Plan, Inspection Level I, AQL of 2.5% for surface defects (ie. burned on sand, cavities, blow holes or other visual defects). The approved pre-production samples define the surface finish required.
- (e) The castings shall be free from cracks and tears when inspected in accordance with BS 6001, Single Normal inspection at Level I and AQL of 0.4%. Inspection shall be by a recognized non-destructive crack testing procedure.
- (f) Hardness: Five percent of shoulders manufactured in Pearlitic Malleable and 10% of shoulders manufactured in Spheroidal Graphite shall be hardness tested.

5.3 Acceptance

- (a) Each production batch shall be accepted if the samples meet all the test requirements.
- (b) All test results shall be treated as independently obtained. In the case of a failure the batch shall be re-inspected to the original sampling plan for the failed property only. If further failures result the batch shall be rejected. In the case of dimensional failures, surface defects, cracks and tears or hardness the batch may be 100% inspected and resubmitted for acceptance.

5.4 Retests

- (a) Should the physical condition or the tests or any part thereon not be met, two further tests shall be made on samples selected from the shoulders represented by the original test.
- (b) Provided the results of both these further tests fulfils the requirements, all the shoulders shall be deemed to comply with this specification.
- (c) If the results of either of the two additional tests do not fulfil the requirements, the shoulders represented shall be rejected.

6. Acceptance of insulators

6.1 Sampling

A minimum of one insulator in every two thousand shall be selected at random and checked for dimensional accuracy and material properties. The insulators shall conform to the dimensions and allowable tolerances detailed in the Drawings.

The acceptance for the insulators shall be made under the conditions in accordance with those for the clips in sub-clause 3 herein.

7. Acceptance of Pads

7.1 Production Quality Control

The following frequency of tests and inspection shall be conducted to ensure the uniformity and high quality of the product:

- (a) 0.50 percent of the production shall be checked for shape deviation and surface condition.
- (b) 1.00 percent of the production shall be checked for dimensions and tolerances. The dimensional checks shall be made by means of GO/NO GO gauges at 24 hours or longer after the pads have been moulded.

7.2 Dimensional Accuracy

- (a) The surface of the pads shall be smooth and free from visible cracks. Deviations of more than 3.0mm from the ideal shape shall not be allowed when a pad is placed on a flat surface without loading. Such deviation shall be measured horizontally using a straight metal rule from the diagonal centre of the plate to the edges.
- (b) No voids in the moulded plate greater than 1mm shall be allowed.
- (c) The pads shall conform to the dimensions and allowable tolerances detailed in the Manufacturer's Drawings.

7.3 Re-tests

In the event of a rejection the test which failed shall be repeated by taking further samples at the same frequency from the rejected production batch. If this repeat test results in a failure the batch shall be rejected except in cases where the batch may be 100% inspected and tested and resubmitted for acceptance.

- (a) Should the conditions in Sub-Clause 7.2 not be met, two further tests shall be made on samples selected from the pads represented by the original test.
- (b) Provided the results of both these further tests fulfil the requirements, all the pads shall be deemed to comply with this specification.
- (c) If the results of either of the two additional tests do not fulfil the requirements, the pads represented shall be rejected.
- (d) The pads rejected on dimensional tolerances may be resorted provided each pad is rechecked.

8. Acceptance of Helical Springs

- 8.1 Helical springs shall be tested to an approved inspection schedule for permanent set. Springs shall be compressed to working load 10 times without suffering any permanent reduction in free length.
- 8.2 Ten pre-production samples of spring shall be subjected to a fatigue test with the spring compression varying between the design pre-load compressions +/- 1.5mm. The test shall be conducted at 10Hz for 250 hours. The free length of each spring shall be examined before and after the test and there shall be no reduction in its length and no evidence of damage or failure.

9. Acceptance of Cast Baseplates

Cast baseplates shall be tested and inspected in accordance with EN1561, EN1562 or EN1563 and the manufacturer's approved procedure.

10. Acceptance of Resilient Baseplates

- 10.1 Resilient Baseplate Pads (Elastomer)

- (a) Resilient baseplate pads shall be tested and inspected in accordance with UIC Code 864-5
- (b) The resilient baseplate pads shall be tested at 21⁰C for deflection after being aged for a minimum of 7 days at 70⁰C in accordance with DIN53508
- (c) The pad shall then be tested and the load/deflection diagram produced for a minimum of 10 load cycles with the deflection being taken up to 5mm.
- (d) The calculated stiffness from the length recording shall not vary from the designed stiffness by more than +/-10%
- (e) The pads shall be fatigue tested by placing a full pad between two steel plates and applying a changeable sinusoidal load in the range 10kN to 70kN at a frequency of 5Hz for a minimum of 2 million cycles. On completion of the test there shall be no sign of physical deterioration of the pad.
- (f) On completion of the fatigue test the pad shall be tested for both static and dynamic stiffness. The dynamic stiffness shall be obtained at the frequencies 10Hz, 20Hz and 40Hz. The test methods for obtaining the dynamic stiffness's shall be submitted by the Contractor for approval.
- (g) The static stiffness test result of one pad under any designed baseplate area at 21⁰C shall be 25Mn/m or the pad designed value.
- (h) The calculated static to dynamic stiffness ratio of the spring coefficients of test results shall be greater than 1.4 at all frequencies list in paragraph (f) above.

10.2 Baseplate Assembly

- (a) The baseplate assembly shall be fixed to precast concrete beam using the method for works and complete with all nuts, bolts, insulators, pads, shim, bushes or ferrules, clips, rail and grout levelling layer as necessary.
- (b) The bushes or ferrules used in the test assembly shall be measured for actual diameter of holding down bolt holes, in a minimum of four equally spaced positions, prior to commencing the tests.
- (c) The baseplates shall be set to gauge, i.e. rails running faces at 1000mm apart.
- (d) The baseplates shall be tested, as detailed hereunder, for fastening repeated load test, electrical insulation test and fastening longitudinal restraint test.
- (e) Three turnout concrete bearer, type1, 2 and 3, as describe below shall be assembled complete with all clips, pads, insulators and rail as per the assembly to be used in the works. These assemblies shall be tested, as detailed hereunder, for fastening repeated load test, electrical insulation test and fastening longitudinal restraint test.
- (f) For the purpose of the tests each type of bearer shall be describe as follows:
 - i) Type 1: Two rail fastening type through the switch slide baseplate area.
 - ii) Type 2: Four rail fastening types through the lead
 - iii) Type 3: Three/four rail fastening types through the checkrail/crossing areas.

10.3 Fastening Repeated Load Test

- (a) Two short sections of rail shall be fastened to each assembly using the complete rail fastening assembly. The repeated load shall be applied by a scissor arm oscillator. The scissor arm oscillator shall be set to apply the load to the rail head at an angle of 26.5⁰ to the vertical
- (b) With the assembly supported as described, a repeated load test shall be undertaken at maximum 5Hz for a minimum of 3 million cycles.
- (c) The loads to be applied to the scissor arm oscillator are as follows:

- i) Baseplate assemblies 90kN
- ii) Concrete bearers 120kN

(d) The minimum load shall be 10kN and the assemblies shall have a static preload applied prior to starting the sinusoidal oscillations and an amplitude and range as defined in the table below

Element	Static preload kN	Amplitude kN	Range kN
Baseplate Assemblies	50	+/-40	10-90
Concrete Bearers	65	+/-55	10-120

(e) Prior to apply the preload and commencing the oscillations the load shall be applied at a rate not exceed 25kN/sec up to 150kN and oscillated for 2000 cycles to ensure the rail is against the outside fasteners. The load shall be released to 20kN maximum and all gauges reset to zero before applying the static preload and commencing the repeated load test. This repeated load test may generate heat in the pads and this heat shall not be allowed to exceed 50°C

10.4 Electrical Insulation Test

- (a) Short pieces of clean rail shall be fitted to an assembly using the complete rail fastening system as specified by the Engineer. The complete assembly shall then be immersed in distilled water for a minimum of 6 hours. Within one hour of removal from the water a DC 10V potential shall be applied across the two rails for period of 15 minutes. If the rails become rusty or contain mill scale, the contact points shall be cleaned.
- (b) The current flow in amperes shall be read using a DC ammeter and the resistance determined by dividing the voltage, 10V, by the current flow in amperes. The requirement of the test shall have been met only when a resistance in excess of 20,000 ohms is recorded.

10.5 Fastening Longitudinal Restraint Test

- (a) The longitudinal restraint test shall be performed in accordance the manufacturer's procedure.
- (b) The requirements of the test shall have been met only when there is no continuous rail movement per fastening assembly with an axle load of not less than 10kN.
- (c) The test shall be undertaken using clean, rust/mill scale free rail without corrosion protection on any components.

8. Guarantee

- 8.1 The Contractor shall guarantee the fastening system against all defects attributable to faulty manufacture, workmanship and quality of material requiring withdrawal from service until one year after the end of the Defects Liability Period. The record of fastening system replacement of the SRT shall be accepted by the Contractor in this connection.
- 8.2 The fastening system components that fail in service before the expiration of the Defects Liability Period shall be replaced free of charge at a depot designated by SRT. The cost of installing replacement fastening system shall be borne by the Contractor. The defective fastening system components withdrawn from service shall be handed over at site to the Contractor for his disposal off railway property.
- 8.3 The Contractor shall make good the cost of such replacement within 60 days of advice of defects, during which period, the Contractor shall inspect the fastening system, make his observations and carry out examination jointly with the SRT's representative.

8.4 Patent Rights

The patent rights of the fastening system shall be the responsibility of the Contractor who will indemnify the Employer against any claim in this connection.

END OF SECTION 8-5