

148

TECHNICAL CONDITIONS  
TP 2260/78  
TORSION BARS

Int. Evid. No. 30 36 056  
ZTS Dubnice.

MASTER COPY  
R&D DOCUMENTATION  
BEML BANGALORE COMPLEX

For GIRIMAL TRANSLATORS

Proprietary

This technical conditions are valid for acceptance of material and finished product TORSION BAR TATRA - 138, 148, 813, 815 and vehicles drawn or derived from these.

Specifications are valid for Torsion bar with product nos. as follows :

442-0-2866-043-4	442-0-2866-051-4
442-0-2866-044-4	442-0-2866-052-4
442-0-2866-046-4	442-0-2866-053-4
442-0-2866-047-4	442-0-2866-054-4
442-0-2866-048-4	442-0-2866-055-4
442-0-2866-049-4	442-0-2866-058-4
442-0-2866-050-4	442-0-2866-059-4

## I. NOMENCLATURE

Torsion bars are flexible elements, which are stressed in torsion. In special cases, from the point of view of tensile stress, could develop as well incremental bending stresses or strain.

## II. GENERAL PART

### 2.1 Utilisation :

The described torsion bars serves to support flexibly the vehicle axles for TATRA 138, TATRA 148, TATRA 813, TATRA 815 and their variants.

Torsion bars work within the climatic range N as per CSN 038206 within the range of temperature of  $-40^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ . Climatic rendering and category of locating the torsion bars is NI as per CSN 038805.

2.2 Description.

Torsion bars have the following basic dimensions :

Drg. No.	Body dia in mm	l = nominal bar length	Head dia of head	l of head	Rendering of the head
442-0-2866-043-4	61h12	1900	79,5h10	65	Involute slots.
442-0-2866-044-4	61h12	1900	79,5h10	65	"-
442-0-2866-046-4	56h12	1900	79,5h10	65	"-
442-0-2866-047-4	56h12	1900	79,5h10	65	"-
442-0-2866-048-4	56h12	1900	79,5h10	65	"-
442-0-2866-049-4	53h12	1900	79,5h10	65	"-
442-0-2866-050-4	58h12	1590	79,5h10	78	"-
442-0-2866-051-4	58h12	1590	79,5h10	78	"-
442-0-2866-052-4	54,5h12	1395	79,5h10	78	"-
442-0-2866-053-4	54,5h12	1395	79,5h10	78	"-
442-0-2866-054-4	52h12	1504	70 <sub>c</sub> 8	92	Flat sur- face for Wedging.
442-0-2866-055-4	52h12	1504	70 <sub>c</sub> 8	92	"-
442-0-2866-058-4	52h12	1144	70 <sub>c</sub> 8	92	"-
442-0-2866-059-4	52h12	1144	70 <sub>c</sub> 8	92	"-

2.3 Ordering : Torsion bars must be ordered in grades as per r related drawings and these technical conditions/specifications.

III. Conditions for manufacture and acceptance of material as per TP-202-76-76 / TŽ- Třinec /

3.1 Material for Torsion bar :

Material of the concerned torsion bars is steel of grade/designation 39 Ni 2 Cr. Manufactured by open hearth furnace and of highly refined steel, is vacuumised with final deoxidation of alloy in dry environment or <sup>atmosphere</sup> in acid converters.

3.2 Steel designation/markings :

Steel is designated or marked with metallurgical designation 39 Ni 2 Cr, in case of non existence of grade standard with CSN designation or specification.

3.3 Ordering :

Information for specifying while ordering are given in dimension standard. Besides CSN standards, technical supply regulations carries the number of technical conditions/specifications TP-202-76-76.

IV. TECHNICAL SPECIFICATIONS

4.1 State or conditions of steel supplied :

Bars or rods are supplied in annealed soft with a maximum hardness of 269 HB. In ordering this condition s are marked or designated 39 Ni 2 Cr in soft annealed conditions, unless otherwise other national conditions are not specified.

4.2 Chemical composition :

Chemical composition of the melt specimen of grade 39 Ni 2 Cr is verified or checked against the following specifications :

C - 0.33 to 0.43	Mo - 0.20 to 0.30
Mn - 0.70 to 1.00	V - min. 0.05

Cr - 0.80 to 1.10  
Si - 0.90 to 1.20  
Ni - 1.40 to 1.70

Cu - Max. 0.10  
Sn - Max. 0.015  
P - Max. 0.025  
S - Max. 0.020

In finished product the following deviations in chemical composition in % is tolerated :

C $\pm$ 0.02	Mo - $\pm$ 0.05
Mn - $\pm$ 0.10	V -
0.05	
Cr - $\pm$ 0.05	Cu -
0.10	
Si - + 0.10	Sn -
- 0.05	
Ni - $\pm$ 0.10	P -
	S -

These deviations are applicable for ingots upto a weight of 5 tons. For products from ingots of weight greater than 5 tons it is necessary to agree upon the permitted deviations in the chemical composition in the finished product.

In case of deviations from these chemical composition, the same must be approved by a resolution from research task from VÚH Ž Praha, TŽ-VŘSR Třinec and the representative of the TATEA factory at Kopřivnice and with customer SMZ Dubnice on Váhom.

#### 4.3 Heat treatment :

Test bar of diameter 10 mm for tensile test with grinding allowance is heat treated as per following procedural specifications :

Harden from temperature  $870^{\circ}\text{C} \pm 5^{\circ}\text{C}/30 \text{ min./-oil}$   
Tempering  $400^{\circ}\text{C}/2\text{hrs/-air}$

Part or body for testing R<sub>3</sub> is heat treated by the defined method after finish machining.

4.4 Mechanical properties :

Values of mechanical properties in the heat treated condition finished as per specifications of para 4.3 must be as follows :

$\sigma_{0.2}$	min. 1275 MPa
$\sigma_{Pt}$	min. 1569 MPa
$\delta_5$	min. 9 %
$\psi$	min. 30 %
$R_3$	min. 29 J/Cm <sup>2</sup>

After establishing sufficient number of results the value of  $R_3$  will be substituted by RV.

4.5 Internal defects :

Micro impurities : On the mechined surface of grade test specimen there shall not be fissures, tear bands, cracks, inclusions and other hair line defects and must conform to the first/correct group of the following table no. 1.

Table No. 1

	Quantity and length of defect	
	I grade	II grade
Total quantity of hairline defects max.	5	8
Max. length of hairline defect	6	8
Total edge length of hairline defect on entire specimen, mm.	25	40
Max. no. of hairline defects on one step/grade	3	4
Total edge length of hairline defects on one step/grade, mm.	10	15

Hairline defects embeded on one surface plane as considered acceptable, as long as the distance between them is as small as 2 mm. Hairline defects, trans itting / or bordering between / from one grade to another grade

is not allowed or acceptable.

For bars of diameter above 60 mm the deviations permitted are according to the second grade in table no. 1 and that to on two grades averaged on nine checks or inspections, i.e., on two grades from three specimen from each melt.

Macro structure :

On fractured surface in fracture test and on etched surface by deep etching there shall not be flakes, coarse pores piping, shrinkage holes, thinning, segregation, blow holes, coarse layers and microscopic non-metallic inclusions. Etched surface must be of fine grain, dull, and dense all along the entire length, and these are characteristic answering the method used for heat treatment.

4.6 Surface grade or quality :

Hot rolled bars, used for manufacture of the subject/article torsion bars, is meant for forming the ends and essential parts of the bar by direct mechanical machining or finishing. On the bars, small and light defects could occur. Depth of such of these defects, however shall not exceed a value of 2 mm for bars of nominal diameter of  $\phi$  52 to 70 mm as per CSN 42 0220.

Upsetting test :

Surface defects are verified or checked by hot upsetting tests on test specimen of height  $h_0$  not equal to  $2d$ , where in "d" is the bar diameter. After upsetting it is equal to  $1/3 h_0$ .

During upsetting test deep surface defects are not permitted or allowed but only those, which are answering to the values of the above table in rolled condition.

4.7 Shape, dimension and Tolerances :

Hot rolled round bars to shape dimension and tolerance is specified in accordance with CSN 42 5515.

4.8 Deviation and tolerences on geometrical shape form and position :

Deviation and tolerences on geometrical shape form and position are given in related dimensional standards.

4.9 Length and its tolerance :

Bar length and its tolerance are given in related dimensional standard.

4.10 Straightness tolerance :

Round bars are supplied straight with a maximum tolerance on straightness of 5 mm on a length of one meter. Total straightness of bar shall not exceed the product of permitted tolerance per meter and the bar length in meters.

4.11 Product information :

Bar bundle will be marked on the table with melt number, diameter, and grade and on every bar in the bundle is marked with acetone colour, the last two digits of the melt number. Colour coding of grade is not permitted or allowed.

V. TESTING.

5.1 A - Method of testing :

For selection or choice and preparation of test specimen for mechanical tests the specifications of standard CSN 42 0305 is applicable. Test bars for tensile tests with finishing allowance for grinding, which is to be done after heat treatment.

Test body for testing micro impurities/grading/are finished from test specimen of the bars of rolled diameter without pre treatment or pre-forging .

Test body for etching test/micro structure / and fracture character test is finished by cross cut from one piece of circular disc of thickness 15 mm from rolled round bars.

5.2 Chemical analysis :

For chemical analysis of steel the methods as per related CSN standards are applicable.

5.3 Tensile test :

For tensile tests CSN 42 0310, CSN 42 0311, CSN 42 0314 are applicable. Tensile tests are done on shortest possible test bar.

5.4 Notch impact strength tests :

For notch impact strength tests CSN 42 0381 is applicable. Type of test body or specimen is  $R_3$ /in case of changes or amendment - RV /.

5.5 Internal defects :

Internal defects, such as hairline defects and series of inclusions, internal cracks, fissures, coarse pores, inclusions, piping, shrinkage holes, thinning, segregation, blow holes, coarse layers, microscopic non-metallic inclusions are determined by micro impurities tests, i.e., grading tests, fracture characteristics tests, and etching tests.

5.6 Micro impurities tests/ grading /.

From unworked round bar of steel, is obtained by working out a test specimen in three grades or stages of dimensions as per bar diameter, as given in the following table No. 2.

Table No. 2

Bar diameter in mm	Diameter of step or stage mm			length of step or stage in mm
	First	Second	Third	
Over 50 to 60	upto 4	32	15	50
Over 60 to 70	upto 5	40	20	50

Upto .....nominal diameter.

Specimen are fine turned to or with a depth of cut of 0.5 mm and feed 0.25 mm/rpm. After mechanical working/ machining of the specimen to the level and evaluate by magnifier or by binocular microscope and test by magnetic particle testing with the help of equipment type DEUTROFLUX HW 700 or similar equipment. Magnification of magnifier or binocular microscope is 6 x.

5.7 Micro structure tests :

Fracture characteristics :

Microstructure tests, characteristics of fracture is done on heat treated specimen body of form/shape of circular disc of thickness 15 mm, cut off from test piece of round steel bar. Sharp edges or notch upto depth of 1/3 the thickness of the disc is worked or finished in the direction of diameter of disc. While fracturing the notch shall be on the tensile side.

5.8 Deep etch test :

Test for microstructure by deep etch test is done according to CSN 42 0467.

5.9 Hardness test :

For verification or inspection of soft annealing is done by Brinell's hardness test as per CSN 42 0371.

5.10 Upsetting test :

Hot upsetting test is done in accordance with CSN 42 0426.

B. VI. ACCEPTANCE VERIFICATION.

6.1 Recommended method of verification - acceptance and supply is necessary to be included or specified in the order and that is done by specifying the first complimentary number after the standard designation CSN 42 0220 as per table. 6 of CSN 42 0220. As per TP-202-76-76, the bars or checked verified and accepted as per CSN 42 0009.

6.2 Selection tests :

Second complimentary number after CSN 42 0220.69 means second test as per CSN 42 0220, table No. 7.

Under the numeral 9 is to be understood as tensile test, notch impact strength  $R_3$  / after amendment change - RV / fracture characteristics, deep etch test, with all group of tests in heat treated condition, micro impurities test, i.e., grading tests in soft annealed condition, hardness test of bars in soft annealed conditions and hot upsetting tests.

6.3 Scope and range of tests :

Bars are checked and verified as per groups depending on melt lot. One group is formed or produced or identified under melt number and bar dimension. For individual tests the following quantity of number of pieces and specimens are selected.

- a. Tensile test - 2 test specimen for every test specimen.
- b. Notch impact test - 2 test specimen for every three test specimen.
- c. Hardness test - 2 test specimen, from furnace soft annealed bars, minimum 3 pieces for every test specimen.
- d. Micro impurities test - 3 test pieces for every test specimen.
- e. Micro structure test and analysis - one test piece for every test specimen for deep etching.
- g. Upsetting test - Two test pieces for every test specimen.

In case, that one of the values of mechanical tests

is not satisfactory, undertake repeat test of this test on double the number of test specimen taken from other bars of the same group. In case the repeat test is found not satisfactory, do not permit the use of these material for manufacture of torsion bars.

VII. SUPPLY AND PACKING :

- 7.1 Bars are supplied in complete melt lot in border cases one melt lot in two consignments, with which with the first consignment or supply, information of partial delivery must be indicated.

Elapsed time between two consignments or delivery shall not be greater than one month.

VIII. REPLACEMENT OF MATERIAL :

- 8.1 Purchaser has a right to check at random the supplied material. In case the properties of material are not satisfactory as per TP - 202-76-76, and incidental, unsatisfactory product grade due to / resulting from material defects, the customer/purchaser has a right to claim upto 9 months. Metallurgical experts shall assist in the claims to resolve the defects in manufacturing Torsion bars, as long as these are related to material defects.

IX. CONDITIONS/SPECIFICATIONS FOR FORGING TORSION BARS.

9.1 Forging :

- 9.1.1 Material supplied from metallurgical shops/smelting works must be stacked and stored according to melt number.

- 9.1.2 While heating the rod/bar for upsetting the head, one must not exceed the temperature range and duration of heating specified by production process sheet.

- 9.1.3 Bars while cooling after upset heading must not be allowed to be <sup>over hanging</sup> in air, or quenched by laying on wet floor and for retarding the cooling rate it is recommended to

stack and store them together. One on each other, such that there is a free course of pre-crystallisation from Fe to Fe.

- 9.1.4 While tempering the temperature and duration specified by the production procedure sheets must be adhered to and the rate of cooling must be held uniform for the entire lot. Hardness after annealing must not be greater than HB 26 g.
- 9.1.5 Forged surface is raw in character. Flashes fins and burrs must be eliminated as per CSN 42 0277 No. 64. On the forging must be stamped covering note/number of melt lot.
- 9.1.6 Finished forgings of torsion bars must conform to semi product drawing.

9.2 Acceptance of Forgings :

- 9.2.1 Forgings for torsion bars are supplied with material certificate, which must contain the metallurgical attestation, as per point or para 4.11 and signed by the forge shop superintendent, that while manufacturing the related production and procedures have been adhered to.

X. SPECIFICATIONS/CONDITIONS OF FINISHED TORSION BARS.

10.1 Mechanical finishing/machining :

- 10.1.1 Forgings for Torsion bars are manufactured as per valid or applicable TP and semi product drawings.
- 10.1.2 Straightening of Torsion bars are done under cold condition and crookedness non-straightness is checked over the entire length, with which the straightness deviation shall not be greater than 1 mm.
- 10.1.3 While machining all the operations specified in the production methodology must be adhered to. During the first operation of machining it must be possible to obtain

uniform chips over the entire length. Maximum deviation / tolerance / is that corresponding to the non-straightness of the Torsion bar.

10.1.4 Most important is specially the smooth transition of cylindrical part of the bar to the bar head termination. With every/all torsion bars as described in para 2.2 of this TP there shall not occur other sizes, non-uniformity of surface/diameter jumps or steps, under cutting due to oscillation of tools etc. it must only be as per specified drawing with permitted tolerances.

10.1.5 Torsion bars finish machined must be dimensionally conform to all dimensions and tolerances as specified in the drawings.

#### 10.2 Heat treatment - Refining.

Torsion bars could be treated for hardening only in furnaces with regulations for neutral atmosphere, so that it prevented decarbonisation of bar/rod surface.

In case, that the works/factory does not have at disposal furnace with protected atmosphere, could undertake this work carefully, such that on the expediated/worked torsion bars, there shall not be decarburised layer under microscopic examination using 100 x magnification.

Check/verification of decarburisation is undertaken by ORKA regularly on every thousand piece.

10.2.2 Regarding refinement by heat treatment the torsion bars the protocol lies with ORKA.

Inspection check/verification of refinement by heat treatment is undertaken for all types of Torsion bars for 10 % of the consignment/batch, test for hardness HB or by Tirooskop. Non-uniformity of heat treated along the length of Torsion bar could be a maximum of 150 MPa, with which after all the torsion bars are heat treated, the range of strength permitted is 1450 to 1650 MPa/ 432 to 481 HB. Decressive

test for strength is Brinell hardness test / HB /.

10.2.3 Straightening of Torsion bars is done after heat treatment in accordance with special production, which is a part of the specification on heat treatment procedures.

10.3 Roller burnishing :

Roller burnishing torsion bars is undertaken with the aim of strengthening the surface and the entire length of the slot/<sup>spline root</sup>~~holders~~ and development of permanent set or stress, for increasing the longevity of the torsion bar during service.

10.3.2 Roller burnishing <sup>of slot/spline</sup> of bar and rounding off of the transition part such as ~~Root~~ <sup>Root</sup> of SPLINE OR SLOT is undertaken with the help of equipment specified in the production process procedures and methodology.

10.3.3 Roller burnishing is done with the help of rollers as specified in related drawings given in para 2.2, of this TP.

10.3.4 Roller burnishing of the <sup>OF</sup> SPLINE/SLOT/the bar and rounding off of the transition parts is necessary to be done upto the ~~Root~~ <sup>Root</sup> of the teeth, or the entire root upto a maximum of 3 mm.

10.3.5 Value of pressure of burnishing on rollers during the course of roller burnishing must be in accordance with the related associated drawings given in para 2.2 of this TP. Feed during roller burnishing must not exceed 0.5 mm/rpm.

10.3.6 Roller burnishing of spline/slot of the bar and rounding off of the transition parts is done in one stroke of stretch or transit. It is permitted to roller burnish the entire bar in individual parts of the bar in two transitions or operations.

10.3.7 In order to avoid jamming or seizure and chattering,

it is permitted to use oil during roller burnishing.

- 10.3.8 Check on grade or quality of roller burnishing of the entire bar is subjected to the actual inspection regime of roller burnishing and external visual inspection and must be done according to specified conditions as per related drawings as per para 2.2 of this TP.
- 10.3.9 QCD/OTK department of the manufacturer of Torsion bars undertakes the inspection for roller burnishing as per para 10.3.4 to 10.3.7 of this TP. Quality grade inspection of roller burnishing is done by QCD/OTK Personnel for all torsion bars.
- 10.3.10 Quantity of roller burnished / <sup>area of spline or</sup> slot, rounding off of the transition parts and ~~the~~ root of tooth over the entire length is inspected against guage / etalon / approved by the QCD department chief / Department of quality control / of the manufacturer's works, in association with design department of the works, and production department and the central metrology laboratory of the works.
- 10.3.11 No undercuts, notches on the entire length of the roller burnished surface is permitted.
- 10.3.12 It is permitted to repeat roller burnishing the entire rod/bar or individual parts in conformity with the specified procedures.
- 10.3.13 It is permitted to press in by rollers on the roller burnished surface and within the limits the corresponding specimen guage / etalon /. It is permitted to correct the pressure on tooth at locations of transition parts.
- 10.3.14 QCD/OTK personnel <sup>Carefully</sup> check and verify/ inspect the surface quality of the rollers used. Change/<sup>Deviation</sup> from cylindrical shape of cylindrical burnished surface of rollers, used for roller burnishing of Splines or slots of transition parts during the course of working as well as upto development of sliding or skidding or friction "bands" in width upto a maximum of 1 mm, is permitted or

allowed.

10.3.15 After roller burnishing and while preparing the torsion bar it is recommended to handle or touch the bar with or in dry leather hand gloves. Bars/rods must be protected against humidity and mechanical damages.

10.3.16 Wherever it is not possible, during the time after roller burnishing, to protect the bars by definite surface treatment, it is necessary to let the bar into protective grease.

#### 10.4 PRE STRESS BY TORSION/PRE TORQUE.

10.4.1 While prestressing by torsion one must adhere to the values given in the drawings as per article or para 2.2 of this TP.

Pre stressing by Torsion, inspection and verification must be done as per production specification.

10.4.2 After prestressing by torsion there shall not occur visible milled surface of head and involute splines or slots, depression after/due to clamping wedges or sleeves of pre torquing/stressing equipment or machine. This is especially important for splines and slots, mainly on its boundary near the body of the bar.

10.4.3 After pre stressing by torsion, every torsion bar is checked for surface defects by electromagnetic flux flow method. Parameters and electromagneto defectoscope method of inspection are given in the annexure to this TP. In case of occurrence or indication of characteristic inclusions and occlusions, it is necessary to eliminate all these upto absolute clean metal and that also only within the range of tolerance, after which, the torsion bar will not be further burnished by roller. If the clean material within the tolerance range is not obtained the torsion bar is rejected, and scrapped.

10.4.4 Contact point/burn out point after electrical discharge on burnished surface, milled rough surface on the involute splines or slots indicated by magnetic defecto-

scope tests are not permitted.

This is excepted only on the face surface of the head.

10.4.5 Every finished Torsion bar must be marked on the face or front of the cover with melt/lot number, ORKA/QCD stamp of the manufacturer and manufacturing number of the Torsion bar.

10.5 Surface treatment :

10.5.1 Surface treatment of Torsion bars is done as per production specification no. U 056, which describes the painting system and methods.

1x S 2008, layer depth 10 to 14  $\mu\text{m}$

1x U 2050, layer depth 30 to 40  $\mu\text{m}$

1x glass cloth

1x U 2050

10.5.2 It is permitted to have surface without laminate and that to 5 to 8 mm from the root of the / beginning of the splines or slots, while this surface must be protected by suitable anti corrosive mastic/dense paint.

The mastic/dense paint is not permitted to seep into the root of the spline or slots.

10.6 Acceptance tests of finished Torsion bars :

10.6.1 Customer has a right to inspect, check and verify the Torsion bars at random during the course of manufacturing and to the acceptance tests by the customer's works.

10.6.2 If during random check tests by the customer on some of the torsion bars, some tests proved not satisfactory and not in conformity with this TP, a repeat check with/on double the quantity is to be done. If further some of the tests during repeat tests are not conforming to this TP, the entire consignment/supply, could be/is

rejected. By agreement with supplier and at his cost inspection of all the pieces of the entire supply/consignment could be undertaken. A protocol report of acceptance tests is to be prepared.

10.6.3 For supply and acceptance of Torsion bars the trade regulations 109/64 Sb / general / and Announcement No. 135/64 Sb and the specification/prescription amendments and changes.

10.6.4 Manufacturer sends along with the supply of consignment corresponding certificates for grade and workmanship of the product as per this TP. on which will be given the product number of the Torsion bars.

#### 10.7 TRANSPORTATION, STORAGE AND OTHERS.

10.7.1 Transportation and preparation of Torsion bars for transportation is allowed/permitted only in crates and with wooden section elements/parts such that, they are arrested from relative movement. During the course of manufacturing and also transportation, damage of Torsion bar surface should not occur.

10.7.2 All torsion bars must be on surfaces which are not particularly laminated or in layers, and protected by protective grease "P" as per standard CSN 65 7131.

10.7.3 During storage the following procedure must be followed :

- Storage/preservation must take effect immediately after surface treatment of the Torsion bars is completed.
- Protection vaseline grease is applied by hot application or by immersion in hot bath of vaseline grease, for which the temperature of protection grease is 90° to 100°C.
- Bar Head surface of the bar before preservative treatment must not be wet, moist or greasy.
- Surface to be applied with protective vaseline grease must be clean and complete without tears, flaws and scratches. Vaseline grease layer thickness must be atleast 0.5 mm.

Worked by : M a z ó k Vojtech  
SMZ - VZ - KOS  
Date - 26-5-1976

## Test parameters for testing by magnetic flux method

ANNEXURE to TP No. 1.

1. Object : Torsion Bar.

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2. Drawing No. : 442 - 0 - 2866 - 043 - 4  
442 - 0 - 2866 - 044 - 4

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3. Range of tests : Entire surface of every bar.

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4. Tests are conducted on finished bar after roller burnishing and twisting.

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5. Method of magnetisation : 6. Intensity field :  
by passage of current  
1200 to 1400 A

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7. Detecting fluid : 8. Resolvable/resolution of  
Clear as per CSN 015015 deflection of indicator:  
4 to 5

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9. Permitted range of non homogeneity : On the surface of torsion bars, scratches or dimples or pressed spots developed by mechanical damage is not permitted. Further on the surface of the torsion bar, there shall not be defects of the character of burrs, fins, flashes, inclusions occlusions etc. Indicated or identified defects of the nature of inclusions and occlusions must be cleaned within the range of the permitted tolerance / by filing or emery cloth/.

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10. Defective spot identity: 11. Reporting in documentation:  
Not specified or marked. Describe in the test protocol report.

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12. Documentation archived 13. Termin : 5 years.  
by : ORKA.

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14. Method of demagnetisation: 15. Degree of demagnetisation:  
not specified. Total.

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16. Elimination of residual 17. Inspection rendered by /cn:  
contact fluid: Basis of the customer's  
not specified. representative.

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18. Notes: Conducting the tests, inspection, verification and service of electro magnetic defectoscopy and inspection of detector fluid is done in conformity with CSN 015015.

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19. Worked by : 20. Approved by:

## Test parameters for testing by magnetic flux method.

ANNEXURE to TP No. 2

1. Object : Torsion Bar.

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2. Drawing No. : 442 - 0 - 2866 - 046 - 4  
442 - 0 - 2866 - 047 - 4

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3. Range of tests : Entire surface of every bar.

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4. Tests are conducted on finished bar after roller burnishing and twisting.

---

5. Method of magnetisation : 6. Intensity field :  
by passage of current : 880 to 970 A

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7. Detecting fluid : 8. Resolvable/resolution of  
Clear as per CSN 015015 deflection of indicator:  
4 to 5

---

9. Permitted range of non homogeneity : On the surface of torsion bars, scratches or dimples or pressed spots developed by mechanical damage is not permitted. Further on the surface of the torsion bar, there shall not be defects of the character of burrs, fins, flashes, inclusions occlusions etc. Indicated or identified defects of the nature of inclusions and occlusions must be cleaned within the range of the permitted tolerance / by filing or emery cloth/.

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10. Defective spot identity: 11. Reporting in documentation:  
Not specified or marked. Describe in the test protocol report.

---

12. Documentation archived 13. Termin : 5 years.  
by : ORKA.

---

14. Method of demagnetisation: 15. Degree of demagnetisation:  
not specified. Total.

---

16. Elimination of residual 17. Inspection rendered by /on:  
contact fluid: Basis of the customer's  
not specified. representative.

---

18. Notes: Conducting the tests, inspection, verification and service of electro magnetic defectoscopy and inspection of detector fluid is done in conformity with CSN 015015.

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19. Worked by : 20. Approved by :

## Test parameters for testing by magnetic flux method

ANNEXURE to TP No. 3

1. Object : Torsion Bar.
2. Drawing No. : 442 - 0 - 2866 - 048 - 4  
442 - 0 - 2866 - 049 - 4
3. Range of tests : Entire surface of every bar.
4. Tests are conducted on finished bar after roller burnishing and twisting.
5. Method of magnetisation : by passage of current  
1000 to 1200 A
6. Intensity field :
7. Detecting fluid : Clear as per CSN 015015
8. Resolvable/resolution of deflection of indicator:  
4 to 5
9. Permitted range of non homogeneity : On the surface of torsion bars, scratches or dimples or pressed spots developed by mechanical damage is not permitted. Further on the surface of the torsion bar, there shall not be defects of the character of burrs, fins, flashes, inclusions occlusions etc. Indicated or identified defects of the nature of inclusions and occlusions must be cleaned within the range of the permitted tolerance / by filing or emery cloth/.
10. Defective spot identity: Not specified or marked.
11. Reporting in documentation: Describe in the test protocol report.
12. Documentation archived by : ORKA.
13. Termin : 5 years.
14. Method of demagnetisation: not specified.
15. Degree of demagnetisation: Total.
16. Elimination of residual contact fluid: not specified.
17. Inspection rendered by /on: Basis of the customer's representative.
18. Notes: Conducting the tests, inspection, verification and service of electro magnetic defectoscopy and inspection of detector fluid is done in conformity with CSN 015015.
19. Worked by :
20. Approved by:

## Test parameters for testing by magnetic flux method

ANNEXURE to TP No. 4

1. Object : Torsion Bar.
2. Drawing No. : 442 - 0 - 2866 - 050 - 4  
442 - 0 - 2866 - 051 - 4
3. Range of tests : Entire surface of every bar.
4. Tests are conducted on finished bar after roller burnishing and twisting.
5. Method of magnetisation : 6. Intensity field :  
by passage of current  
910~~5~~ to 1000 A
7. Detecting fluid : 8. Resolvable/resolution of  
Clear as per CSN 015015 deflection of indicator:  
4 to 5
9. Permitted range of non homogeneity : On the surface of torsion bars, scratches or dimples or pressed spots developed by mechanical damage is not permitted. Further on the surface of the torsion bar, there shall not be defects of the character of burrs, fins, flashes, inclusions occlusions etc. Indicated or identified defects of the nature of inclusions and occlusions must be cleaned within the range of the permitted tolerance / by filing or emery cloth/.
10. Defective spot identity: 11. Reporting in documentation:  
Not specified or marked. Describe in the test protocol report.
12. Documentation archived 13. Termin : 5 years.  
by : ORKA.
14. Method of demagnetisation: 15. Degree of demagnetisation:  
not specified. Total.
16. Elimination of residual 17. Inspection rendered by /on:  
contact fluid: Basis of the customer's  
not specified. representative.
18. Notes: Conducting the tests, inspection, verification and service of electro magnetic defectoscopy and inspection of detector fluid is done in conformity with CSN 015015.
19. Worked by : 20. Approved by:



## Test parameters for testing by magnetic flux method

ANNEXURE to TP No. 6

1. Object : Torsion Bar.
- 
2. Drawing No. : 442 - 0 - 2866 - 054 - 4  
442 - 0 - 2866 - 055 - 4
- 
3. Range of tests : Entire surface of every bar.
- 
4. Tests are conducted on finished bar after roller burnishing and twisting.
- 
5. Method of magnetisation : 6. Intensity field : 50-55 A/cm  
by passage of current  
810 to 900 A
- 
7. Detecting fluid : 8. Resolvable/resolution of  
Clear as per CSN 015015 deflection of indicator:  
4 to 5
- 
9. Permitted range of non homogeneity : On the surface of torsion bars, scratches or dimples or pressed spots developed by mechanical damage is not permitted. Further on the surface of the torsion bar, there shall not be defects of the character of burrs, fins, flashes, inclusions, occlusions etc. Indicated or identified defects of the nature of inclusions and occlusions must be cleaned within the range of the permitted tolerance / by filing or emery cloth/.
- 
10. Defective spot identity: 11. Reporting in documentation:  
Not specified or marked. Describe in the test protocol report.
- 
12. Documentation archived 13. Termin : 5 years.  
by : ORKA.
- 
14. Method of demagnetisation: 15. Degree of demagnetisation:  
not specified. Total.
- 
16. Elimination of residual 17. Inspection rendered by /on:  
contact fluid: Basis of the customer's  
not specified. representative.
- 
18. Notes: Conducting the tests, inspection, verification and service of electro magnetic defectoscopy and inspection of detector fluid is done in conformity with CSN 015015.
- 
19. Worked by : 20. Approved by:

Test parameters for testing by magnetic flux method.

ANNEXURE to TP No. 7

1. Object : Torsion Bar.
2. Drawing No. : 442 - 0 - 2866 - 058 - 4  
442 - 0 - 2866 - 059 - 4
3. Range of tests : Entire surface of every bar.
4. Tests are conducted on finished bar after roller burnishing and twisting.
5. Method of magnetisation : 6. Intensity field : 50- 55 A/cm  
by passage of current  
810 to 900 A
7. Detecting fluid : 8. Resolvable/resolution of  
Clear as per CSN 015015 deflection of indicator:  
4 to 5
9. Permitted range of non homogeneity : On the surface of torsion bars, scratches or dimples or pressed spots developed by mechanical damage is not permitted. Further on the surface of the torsion bar, there shall not be defects of the character of burrs, fins, flashes, inclusions occlusions etc. Indicated or identified defects of the nature of inclusions and occlusions must be cleaned within the range of the permitted tolerance / by filing or emery cloth/.
10. Defective spot identity: 11. Reporting in documentation:  
Not specified or marked. Describe in the test protocol report.
12. Documentation archived 13. Termin : 5 years.  
by : ORKA.
14. Method of demagnetisation: 15. Degree of demagnetisation:  
not specified. Total.
16. Elimination of residual 17. Inspection rendered by /on:  
contact fluid: Basis of the customer's  
not specified. representative.
18. Notes: Conducting the tests, inspection, verification and service of electro magnetic defectoscopy and inspection of detector fluid is done in conformity with CSN 015015.
19. Worked by : 20. Approved by: