

NORFIX / NTS / PINTOS


REPORT:


Initial Type Testing
EN 14592

Nails

Translation

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1 OBJECTIVE

NORFIX / NTS / PINTOS companies manufacture nails for use in load bearing timber structures.

The conformity with the requirements of the standard EN 14592 shall be demonstrated by:

- Initial type testing,
- Factory production control by the manufacturer, including product assessment.

For the purposes of testing, the products may be grouped into families, where it is considered that the results for one or more characteristics from any one product within the family are representative for those same characteristics for all the products within that same family.

Tests previously performed in accordance with the provisions of the standard EN 14592 (i.e. same product, characteristic(s), test method, sampling procedure, system of attestation of conformity, etc.) may be taken into account for the ITT purpose.

FCBA carried out this assessment. The objective is to:

- Take into account previous tests reports (VTT, CTBA)
- Carry out new testing
- State the relevant characteristics of the nails
- Write the present report

This report is based on the reports:

- FCBA n°403/08/339/09/257 dated September 7th 2009
- VTT N°RTE 4447/05 dated December 9th 2005
- VTT N°VTT-S-04640-06 dated May 12th 2006
- CTBA N°2001.371312 dated November 28th 2001

Remark:

In addition, initial type testing shall be performed at the beginning of the production of a new product type or at the beginning of a new method of production (where this may affect declared values of the products stated characteristics).

Whenever a change occurs in the product, the raw material or supplier of the components for the product, or the production process, which would change significantly one or more of the characteristics, the initial type testing shall be repeated for the appropriate characteristic(s).

2 GENERAL

Initial type testing shall be performed to show conformity with the standard EN 14592.

Depending on the nails (smooth, threaded, etc.), the relevant properties shall be stated and declared from test results or calculation.

The relevant properties and parameters are given in the following Table.

All nails
Characteristic tensile strength of wire $f_{u,k}$
Nominal diameter
Length
Head cross-sectional area
Head thickness
Tolerances
Smooth nails (round or grooved)
characteristic yield moment $M_{y,k}$
characteristic withdrawal parameter $f_{ax,k}$
characteristic head pull through parameter $f_{head,k}$
characteristic tensile capacity $f_{tens,k}$
Threaded nails
characteristic yield moment $M_{y,k}$
characteristic withdrawal parameter $f_{ax,k}$
characteristic head pull through parameter $f_{head,k}$
characteristic tensile capacity $f_{tens,k}$
length of the threaded part

The “No performance determined” (NPD) option may be used when and where the characteristic, for a given intended use, is not subject to a threshold level and to regulatory requirements in the Member State, where the products are intended to be used.

It is the case for:

- characteristic head pull through parameter $f_{head,k}$
- characteristic tensile capacity $f_{tens,k}$

These properties were not stated by testing for threaded nails. The “No performance determined” (NPD) option may be used. Nevertheless, we propose in the present document an approach by conservative calculation.

The range of the nails covered in this report is:

- Flat head, bright, grooved, diameter 2 to 6 mm
- Flat head, bright, round, diameter 2.8 to 3.1 mm
- Flat head, hot did 50µm, round, diameter 2.8 to 3.1 mm

- Flat head, hot did 50µm, grooved, diameter 2 to 6 mm
- Flat head, hot did 50µm, annular ring, diameter 2.3 to 3.1 mm
- Convex head, stainless A4, annular ring, diameter 1.9 to 5.1 mm
- Anchorage nails, stainless A4, annular ring, diameter 4 to 6 mm
- Flat head, electro zinc plated, annular ring, diameter 2.1 to 3.1 mm
- Anchorage nails, electro zinc plated, annular ring, diameter 3.4 to 6 mm
- Large head, bright, round, diameter 2.4 to 5.5 mm
- Large head, hot did 50µm, round, diameter 2.4 to 5.5 mm
- Plastop, stainless A4, annular ring, diameter 2.0 to 3.1 mm

Translation

3 ANALYSIS

3.1 GENERAL

The requirements of EN 10230-1 on dimensions, tolerances and surface coatings of the nails shall be fulfilled.

3.2 MATERIAL

The wire is drawn from either non-alloy steel rods produced in accordance with EN 10016 (all parts), or wire drawn from austenitic stainless steel rods produced in accordance with EN 10083-1 or EN 10088-2.

The Nails are produced from a wire with a minimum tensile strength $f_{u,k}$ of 600 N/mm². The stated values are:

Nails	Diameter mm	$f_{u,k}$ N/mm ²
Flat head, bright, grooved	2.0 – 2.3 – 2.8 – 3.1 – 3.4 – 3.7	770
Flat head, bright, grooved	4.0 – 5.1 – 5.4 – 6.0	700
Flat head, bright, round	2.8 – 3.1	770
Flat head, hot did 50µm, round	2.8 – 3.1	660
Flat head, hot did 50µm, grooved	2.0 – 2.3 – 2.8 – 3.1 – 3.4 – 3.7	660
Flat head, hot did 50µm, grooved	4.0 – 5.1 – 5.4 – 6.0	630
Flat head, hot did 50µm, annular ring	2.3 – 2.5 – 2.8 – 3.1	660
Convex head, stainless A4, annular ring	1.9 – 2.1 – 2.3 – 2.5 – 2.8 – 3.1 – 4.0 – 5.1	700
Anchorage nails, stainless A4, annular ring	4.0 – 6.0	700
Flat head, electro zinc plated, annular ring	2.1 – 2.3 – 2.5 – 2.8 – 3.1	770
Anchorage nails, electro zinc 15 µm, annular ring	3.4 – 3.7	770
Anchorage nails, electro zinc 15 µm, annular ring	4.0 – 6.0	700
Flat head, bright, round	2.4 – 2.7 – 3.0 – 4.0 – 5.5	770
Flat head, hot did 50µm, round	2.4 – 2.7 – 3.0 – 4.0 – 5.5	660
Plastop, stainless A4, annular ring	2.0 – 2.5 – 3.1	700

3.3 GEOMETRY

The nominal diameters, d , of nails are from 1,9 mm up to 6,0 mm with dimensional tolerances less than 2.5%.

The nominal lengths L of nails have dimensional tolerances less than 2.5%.

The diameter of the nail head, d_h , is always greater than $2.3d$. Then, the area of the nail head, A_h , is always greater than $4.15d$.

the lengths of the point, l_p , are greater than $0,5.d$ and less than $1,5 d$.

For profiled nails the length of the threaded part is greater than $4,5 d$.

3.4 MECHANICAL STRENGTH AND STIFFNESS

3.4.1 General

The following characteristic properties can be declared:

- characteristic yield moment,
- characteristic withdrawal parameter,
- characteristic head pull-through parameter,
- characteristic tensile capacity.

The characteristic strength results for nails are declared either directly from tests or, in certain cases and types of nails, from calculation or equations given in EN 1995-1-1. Where characteristic strength values are declared from test results, they are calculated in accordance with EN 14358.

For the purposes of strength calculations for nailed joints, the nail diameter is taken as the nominal diameter, d .

3.4.2 characteristic yield moment

For the round nails, the characteristic yield moment $M_{y,k}$ is declared by calculation according to the relevant equations given in EN 1995-1-1.

For other nails, testing was carried out in accordance with EN 14592 and EN 409.

Test results were used in accordance with EN 1990 – Annex D to determinate the characteristic yield moment values:

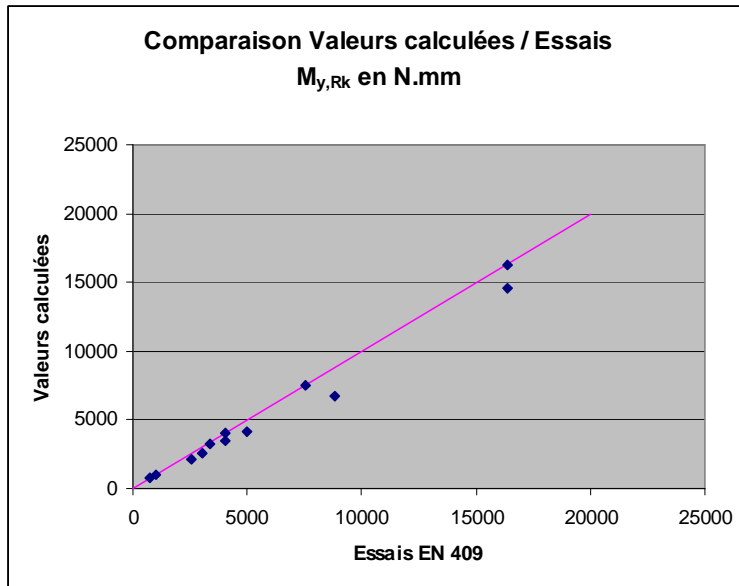
	coating	Type	Dimension	$M_{y,k}$ (N.mm)
FCBA	bright	grooved	3,1 x 80	4048
FCBA	bright	grooved	5,1 x 160	16365
FCBA	Stainless A4	Annular ring	2,0 x 40	774
FCBA	Stainless A4	Annular ring	3,1 x 85	3336

FCBA	Stainless A4	Annular ring	4,0 x 145	7566
FCBA	Zn-Bichro	Annular ring	2,1 x 60	1034
FCBA	Zn-Bichro	Annular ring	2,8 x 80	3049

	Nuance	Type	Dimension	$M_{y,k}$ (N.mm)
FCBA	Hot dip	Annular ring	2,8 x 75	2550
VTT	Hot dip	Annular ring	3,4 x 60	4963
VTT	Hot dip	Annular ring	4,0 x 100	8823
FCBA	Hot dip	grooved	3,1 x 90	4048
FCBA	Hot dip	grooved	5,1 x 160	16365

Two equations are given to calculate the characteristic yield moment. The first one is designed for annular ring nails, the second one for grooved nails. The following table shows test results and calculation.

Coating	Type	d (mm)	$f_{u,k}$ (N/mm ²)	$M_{y,k}$ (N.mm)	Calculation (N.mm)	Diff.
bright	grooved	3,1	770	4048	4014	1%
bright	grooved	5,1	700	16365	16250	1%
stainless A4	Annular ring	2,0	700	774	758	2%
stainless A4	Annular ring	3,1	700	3336	3221	3%
stainless A4	Annular ring	4,0	700	7566	7469	1%
Zn-Bichro	Annular ring	2,1	770	1034	980	5%
Zn-Bichro	Annular ring	2,8	770	3049	2532	17%
Hot dip	Annular ring	2,8	660	2550	2170	15%
Hot dip	Annular ring	3,4	660	4963	4119	17%
Hot dip	Annular ring	4,0	630	8823	6723	24%
Hot dip	grooved	3,1	660	4048	3441	15%
Hot dip	grooved	5,1	630	16365	14625	11%



For nails the characteristic yield moment should be calculated using this table:

Nail	$M_{y,k}$ N.mm
Flat head, bright, grooved	$0,175 \cdot f_{u,k} \cdot d^3$
Flat head, bright, round	$0,3 \cdot f_{u,k} \cdot d^{2,6}$
Flat head, hot did 50µm, round	$0,3 \cdot f_{u,k} \cdot d^{2,6}$
Flat head, hot did 50µm, grooved	$0,175 \cdot f_{u,k} \cdot d^3$
Flat head, hot did 50µm, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$
Convex head, stainless A4, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$
Anchorage nails, stainless A4, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$
Flat head, electro zinc plated, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$
Anchorage nails, electro zinc plated, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$
Large head, bright, round	$0,3 \cdot f_{u,k} \cdot d^{2,6}$
Large head, hot did 50µm, round	$0,3 \cdot f_{u,k} \cdot d^{2,6}$
Plastop, stainless A4, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$

3.5 CHARACTERISTIC WITHDRAWAL PARAMETER

For flat head bright round nails, the characteristic withdrawal parameter $f_{ax,k}$ shall be declared by calculation according to the relevant equations given in EN 1995-1-1.

For other nails, a sampling plan was made to determinate the characteristic withdrawal parameter by testing according to EN 14592.

Characteristic withdrawal parameter was measured on timber with a characteristic density of 350 kg/m^3 (when conditioned to constant mass at $20 \text{ }^\circ\text{C}$ and 65% relative humidity) and calculated in accordance with EN 14358.

	Coating	Type	Dimension	$f_{ax,k}$ (N/mm ²)
FCBA	bright	grooved	3,1 x 80	2,27
FCBA	bright	grooved	5,1 x 160	3,62
FCBA	stainless A4	Annular ring	2,0 x 40	7,45
FCBA	stainless A4	Annular ring	3,1 x 85	5,35
FCBA	stainless A4	Annular ring	4,0 x 145	5,73
FCBA	Zn-Bichro	Annular ring	2,1 x 60	2,94
FCBA	Zn-Bichro	Annular ring	2,8 x 80	3,58
VTT	Hot dip	Annular ring	2,8 x 50	4,00
VTT	Hot dip	Annular ring	2,8 x 65	4,61
VTT	Hot dip	Annular ring	2,8 x 75	4,08
VTT	Hot dip	Annular ring	3,4 x 60	5,63
VTT	Hot dip	Annular ring	4,0 x 100	6,06
VTT	Hot dip	grooved	2,8 x 50	4,53
VTT	Hot dip	grooved	2,8 x 65	2,79
VTT	Hot dip	grooved	2,8 x 75	4,09
VTT	Hot dip	grooved	3,1 x 90	3,71
FCBA	Hot dip	grooved	5,1 x 160	5,04

There is not direct correlation with diameter and $f_{ax,k}$. Results show important variations when testing a single diameter and different lengths of penetration.

In accordance with the equation in Eurocode 5, the value of $f_{ax,k}$ should be independent from the diameter and the length of penetration. Then a global analysis considering nail families instead of test series leads to this values of $f_{ax,k}$:

Coating	Type	$f_{ax,k}$ (N/mm ²)
bright	grooved	1,72
stainless A4	Annular ring	4,44

Zn-Bichro	Annular ring	2,43
Hot dip	Annular ring	4,69
Hot dip	grooved	4,02

NOTE:

This approach was validated to make sure it is conservative when comparing with the experimental 5%-percile directly determined from test results (large sampling from 40 up to 100 samples).

In accordance with the rules in EN 1995-1-1, the declared values on one or more characteristic timber densities should be:

		Grading and ρ_k (kg/m ³)				
		C22	C24	C30	GL24	GL28
		340	350	380	380	410
coating	Type	$f_{ax,k}$ (N/mm ²)				
Bright	grooved	1,62	1,72	2,03	2,03	2,36
stainless A4	annular	4,19	4,44	5,23	5,23	6,09
Zn-Bichro	annular	2,29	2,43	2,86	2,86	3,33
Hot dip	annular	4,43	4,69	5,53	5,53	6,44
Hot dip	grooved	3,79	4,02	4,74	4,74	5,52

According to EN 14592 characteristic withdrawal parameter of threaded nails shall be greater than or equal to 4,5 N/mm² when measured on timber with a characteristic density of 350 kg/m³ when conditioned to constant mass at 20°C and 65% relative humidity (grade C24).

When the characteristic withdrawal parameter of threaded nails is less than 4,5 N/mm² the nails shall be assumed as smooth nails for design in accordance with EN 1995-1-1.

3.6 CHARACTERISTIC HEAD PULL-THROUGH PARAMETER

For smooth nails, the characteristic head pull-through parameter $f_{head,k}$ declared by calculation according to the relevant equations given in EN 1995-1-1.

For all other types of nail, the characteristic head pull-through parameter $f_{head,k}$ shall be declared on one or more characteristic timber densities or on other types of wood based products, by testing in accordance with EN 1383.

But the characteristic head pull-through parameter is not subject to a threshold level and to regulatory requirements in the Member States where the products are intended to be used. The “No performance determined” (NPD) option may be used. This parameter was not stated by testing for threaded nails.

NOTE:

We propose a conservative calculation by using the rules for smooth nails.
Specifically “plastop” nail shall use the NPD option.

3.7 CHARACTERISTIC TENSILE CAPACITY

The characteristic tensile capacity of nails $f_{tens,k}$ (head pull-off or shank tensile capacity) shall be declared by testing in accordance with EN 1383.

But the characteristic tensile capacity is not subject to a threshold level and to regulatory requirements in the Member States where the products are intended to be used. The “No performance determined” (NPD) option may be used.

NOTE:

Experience as well as the test report VTT-S-04640-06 dated 05.12.2006 show that with this range of diameter and length the failure is always due to the withdrawal of the nails. Then for this assessment the characteristic tensile capacity was not stated by testing.

However, in accordance with EN 1993 and the previous VTT report, the characteristic tensile capacity should be calculated as follows:

- $f_{tens,k} = 0,9 \cdot f_{u,k}$ for smooth nails
- $f_{tens,k} = 0,8 \cdot f_{u,k}$ for threaded nails

3.8 CORROSION PROTECTION

For nails, where corrosion protection is required, the grade of the parent material or thickness of coating shall be declared.

4 ASSESSMENT

4.1 GENERAL

The requirements of EN 10230-1 on dimensions, tolerances and surface coatings of the nails are fulfilled.

4.2 MATERIAL

The wire is drawn from either non-alloy steel rods produced in accordance with EN 10016 (all parts), or wire drawn from austenitic stainless steel rods produced in accordance with EN 10083-1 or EN 10088-2.

The Nails are produced from a wire with a minimum tensile strength $f_{u,k}$ of 600 N/mm². The declared values are:

Nails	Diameter mm	$f_{u,k}$ N/mm ²
Flat head, bright, grooved	2.0 – 2.3 – 2.8 – 3.1 – 3.4 – 3.7	770
Flat head, bright, grooved	4.0 – 5.1 – 5.4 – 6.0	700
Flat head, bright, round	2.8 – 3.1	770
Flat head, hot did 50µm, round	2.8 – 3.1	660
Flat head, hot did 50µm, grooved	2.0 – 2.3 – 2.8 – 3.1 – 3.4 – 3.7	660
Flat head, hot did 50µm, grooved	4.0 – 5.1 – 5.4 – 6.0	630
Flat head, hot did 50µm, annular ring	2.3 – 2.5 – 2.8 – 3.1	660
Convex head, stainless A4, annular ring	1.9 – 2.1 – 2.3 – 2.5 – 2.8 – 3.1 – 4.0 – 5.1	700
Anchorage nails, stainless A4, annular ring	4.0 – 6.0	700
Flat head, electro zinc plated, annular ring	2.1 – 2.3 – 2.5 – 2.8 – 3.1	770
Anchorage nails, electro zinc 15 µm, annular ring	3.4 – 3.7	770
Anchorage nails, electro zinc 15 µm, annular ring	4.0 – 6.0	700
Flat head, bright, round	2.4 – 2.7 – 3.0 – 4.0 – 5.5	770
Flat head, hot did 50µm, round	2.4 – 2.7 – 3.0 – 4.0 – 5.5	660
Plastop, stainless A4, annular ring	2.0 – 2.5 – 3.1	700

4.3 GEOMETRY

The nominal diameters declared fulfill the requirements of EN 14592.

The nominal lengths of nails declared fulfill the requirements of EN 14592.

The diameter of the nail head and the area of the nail head fulfill the requirements of EN 14592.

The lengths of the point fulfill the requirements of EN 14592.

For profiled nails the length of the threaded part fulfills the requirements of EN 14592.

4.4 MECHANICAL STRENGTH AND STIFFNESS

4.4.1 characteristic yield moment

For the round nails, the characteristic yield moment $M_{y,k}$ is declared by calculation according to the equation (8.14) given in EN 1995-1-1.

For other nails, the characteristic yield moment should be calculated using this table:

Nail	$M_{y,k}$ N.mm
Flat head, bright, grooved	$0,175 \cdot f_{u,k} \cdot d^3$
Flat head, bright, round	$0,3 \cdot f_{u,k} \cdot d^{2,6}$
Flat head, hot did 50µm, round	$0,3 \cdot f_{u,k} \cdot d^{2,6}$
Flat head, hot did 50µm, grooved	$0,175 \cdot f_{u,k} \cdot d^3$
Flat head, hot did 50µm, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$
Convex head, stainless A4, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$
Anchorage nails, stainless A4, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$
Flat head, electro zinc plated, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$
Anchorage nails, electro zinc plated, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$
Large head, bright, round	$0,3 \cdot f_{u,k} \cdot d^{2,6}$
Large head, hot did 50µm, round	$0,3 \cdot f_{u,k} \cdot d^{2,6}$
Plastop, stainless A4, annular ring	$0,11 \cdot f_{u,k} \cdot d^{3,3}$

4.5 CHARACTERISTIC WITHDRAWAL PARAMETER

For smooth nails, the characteristic withdrawal parameter $f_{ax,k}$ shall be declared by calculation according to the equation (8.25) given in EN 1995-1-1.

For other nails, the declared values should be:

		Grading and ρ_k (kg/m ³)				
		C22	C24	C30	GL24	GL28
		340	350	380	380	410
coating	Type	$f_{ax,k}$ (N/mm ²)				
Bright	grooved	1,62	1,72	2,03	2,03	2,36
stainless A4	annular	4,19	4,44	5,23	5,23	6,09
Zn-Bichro	annular	2,29	2,43	2,86	2,86	3,33
Hot dip	annular	4,43	4,69	5,53	5,53	6,44
Hot dip	grooved	3,79	4,02	4,74	4,74	5,52

According to EN 14592 characteristic withdrawal parameter of threaded nails shall be greater than or equal to 4,5 N/mm² when measured on timber with a characteristic density of 350 kg/m³ when conditioned to constant mass at 20°C and 65% relative humidity (grade C24).

When the characteristic withdrawal parameter of threaded nails is less than 4,5 N/mm² the nails shall be assumed as smooth nails with these declared values for design in accordance with EN 1995-1-1.

4.6 CHARACTERISTIC HEAD PULL-THROUGH PARAMETER

For smooth nails, the characteristic head pull-through parameter $f_{head,k}$ shall be declared by calculation according to the equation (8.26) given in EN 1995-1-1.

For all other types of nail, the “No performance determined” (NPD) option may be used.

NOTE:

A conservative calculation can be used by applying the rules for smooth nails, equations (8.26) and (8.24) given in EN 1995-1-1.

4.7 CHARACTERISTIC TENSILE CAPACITY

For the characteristic tensile capacity of nails $f_{tens,k}$ (head pull-off or shank tensile capacity) the “No performance determined” (NPD) option may be used.

NOTE:

The characteristic tensile capacity should be calculated as follows:

- $f_{tens,k} = 0,9 \cdot f_{u,k}$ for smooth nails
- $f_{tens,k} = 0,8 \cdot f_{u,k}$ for threaded nails

4.8 CORROSION PROTECTION

Where corrosion protection is required, the grade of the parent material or thickness of coating shall be declared in accordance with EN 10088-1, EN ISO 1461 or ISO 2081.

For FCBA

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Translation