

	TECHNICAL DESCRIPTION TWO SECTION (2X2,40) COMBINATION (EXTENDING AND SELF SUPPORTING) LADDERS MADE OF FIBERGLASS	CODE: 802000032
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1. SCOPE

This specification determines the general design features, the test methods and the requirements for the two - section combination ladders.

The ladders are self-supporting of a length of 2.40m and extending of a maximum length of 3,90m), Industrial - Extra Heavy type (1A, ANSI) designed for a maximum working load of 140 kg (300 lbs) and made of fiberglass.

2. DESCRIPTORS

Safety in the workplace, ladder, fiberglass

3. LADDERS' USE AND PROPERTIES

These ladders will be used by electricians' groups for out-doors works. Principally, they will be used for the climbing on wood or concrete electric poles, on buildings, walls, for works that will take place at low or middle voltage networks, as well as for works like trees' pruning.

4. REGULATIONS - SPECIFICATIONS

- EN 131 - 1/91 Ladders, vocabulary, schematic presentation, dimensions.
- EN 131 -2/91 Ladders, Requirements, Testing, Marking.
- ANSI A14.5/92 Ladders, Portable Reinforced Plastic, Safety Requirements.
- ELOT EN 59/82 Glass reinforced plastics. Measurement of hardness by means of a Barcol impressor.
- EN 62/77 Glass Reinforced Plastics standard atmospheres for conditioning and testing.
- DIN 1725/83 Aluminum Alloys

5. DESCRIPTION

5.1. Schematic presentation and dimensions

The ladder shall be constituted from the followings parts (as they are shown, suggestively, in fig.1):

- a. The main ladder (stiles (1) - rungs (2))
- b. The locking device for the fixing of the fly section of the ladder on the base section (3)
- c. An opening restraint device (that will support the two sections in case that the ladder is used as a self - supporting ladder) (4)
- d. The stay up system
- e. The anti - slip devices of fly section.

5.1.1. The main ladder

The main ladder shall be constituted by 2 sections:

- The base section of 2.40m of length,
- The fly section of 2.40m too.

The maximum extended length will be 3,90m (in case that the ladder is used as an extending ladder).

Each ladder will have **a restraining device** that will prevent the use of the ladder when the overlapping length of the 2 sections is less than what provided in this specification.

The two sections overlapping length, when the ladder will be in the maximum extended length, will be **at least 90cm** (as provides ANSI A 14.5)

The restraining of the two sections that overlap the one the other, shall be effectuated with metal plates.

Each section will include:

- stiles
- rungs

5.1.1.1 Stiles

The stile shall be preferably of a rectangular shape, that reassures equal safety and usability.

5.1.1.2 Rungs

The rung conjunction to the stile of the ladder shall be realised with the insertion of two washers, externally and internally, before the pressing.

Ladders, the rungs of which will be joined to the stile in a different way, shall be acceptable on condition that the units shall show no indication of test failure after the Repeated Stile Loading Tests according to ANSI A 14.5 (§ 8.7.2.2) or another equivalent National Standard.

All rungs shall be made of aluminum, they shall be of non-slip type, preferably **of a rectangular shape with rounded edges** and dimensions 30±2mm. The dimensions shall be the dimensions provided in EN 131-1 and more definitely:

- The minimum inner width for the fly section shall be 30cm.
- The distance between two successive rungs and between the bottom edge of the ladder and the lowest rung shall be 25-30cm for each rung. In all positions of use of the ladder, the rungs of the two sections of the overlapping part of the ladder shall be coincided.
- The distance from the top rung to the upper edge of the ladder shall be 35±5 cm.
- The distance between the top rung and the next rung shall be such as the top rung not to be adjacent to the pole, when the ladder is in the safe position of use (inclination 4:1)

5.1.3. Fly section' s locking device.

The fixing of the fly section of the ladder, on the base section shall be effectuated with the locking device.

The locking device shall be constituted by reinforced hooks and plates which shall be in such a manner that not allow the removal of parts.

5.1.4 Restraining device

There will be a restraining device that will permit the use as a self supporting ladder, won't permit the separation of the two sections of the ladder and that will ensure its safe use (with an inclination 4:1) when the ladder is used as a self-supporting ladder.

5.1.5 Anti slip devices

For the position of the ladder on the ground, shall be **a traverse of aluminum or fiberglass**, having a extended length from both the stiles, less than 20 cm. the bottom ends of the traverse The anti-slip coating of the shoes shall be cleated. (5,fig.1)

The bottom ends of the fly part of the ladder shall be provided with the same slip proof shoes.

Above the top rung of the ladder there will be a wire rope (6) provided with plastic rollers, of a cylindrical shape, for securing the ladder to the electric poles. Besides, at the upper part of the ladder there will be a cleated anti-skid top cup of a length of 10cm, at least, for its supporting on the wall In its upper part the ladder shall have a belt for fastening to the pillar.

5.2 Materials' Technical characteristics

5.2.1 Stiles

The stiles shall be made of fiberglass and their external finish shall be well-done. The surface of the stiles shall be of an unvarying colour and smooth without protruding plastic fibers. The stiles' surface shall also be free from foreign bodies, conductive components, holes, strokes, blanks, scrapings, ruffles or blisters. The glass fibers shall be equally allocated as not to be any density variation. The fiberglass physical and mechanical properties shall be in accordance with the provisions of the § 6.2.2.1.3

5.2.2 Rungs

The rungs shall be made of aluminum. They shall be of an anti-slip type and shall have such a shape that will ensure a safe and easy ascent or descent.

5.2.3 Hooks

The hooks shall be made of aluminum alloy, of a **G AISi 12** type according to **DIN 1725** or other equivalent National or International Standard.

5.2.4 Anti-slip coatings

The anti-slip coatings shall be made of **neopren** or other equivalent material.

5.3 Weight

The total weight of the ladder won't exceed the 16 kg.

6. TESTS

6.1. Design tests

Not necessary

6.2. Type tests

6.2.1 Visual test

The shape and the dimensions of the ladders shall comply with what it is described in § 5.

6.2.2 Laboratory tests

6.2.2.1 Test of the stile material

6.2.2.1.1 Test of hardness

The material's hardness shall be, at least, of 35 degrees, on the Barcol scale, in accordance with the ELOT EN-59.

6.2.2.1.2 Drilling test (ANSI A 14.5/92 § 7.8)

The material shall be capable of being bored, punched and riveted without splitting or delaminating. For this aim, shall take place a drilling test with a pin tapered to 1,04 times the hole diameter.

6.2.2.1.3 Test of physical and mechanical properties

The test piece of fiberglass shall have the following properties:

- Density 0,065 lb/in³ (1,8gr/cm³) with a tolerance of + 10 %
- Water absorption 0,75 % max in accordance with ASTM D 299/91.
- The material must comply with the requirements presented in table 1 when it is conditioned according to ASTM D 709/78, when it is immersed for two hours in boiling distilled water and then in water that is at room temperature, as well as when it is heated up to 150°F (66°C). (Table 6 according to ANSI A. 14,5- 92) .

Table 1
Minimum values of fiberglass mechanical properties

Material Property – Test Conditions	According to ASTM D 709/78	Wet	66° C	Weathering
Flexural Strength (PSi)	35.000	26.000	26.000	28.000
Flexural Modulus (10 ⁶ PSi)	1,8	1,4	1,4	1,4
Tensile Strength (PSi)	30.000	23.000	21.000	23.000
Tensile Modulus (10 ⁶ PSi)	2,0	1,5	1,4	1,5
Compressive Strength (PSi)	28.000	21.000	19.000	22.000
Compressive Modulus (10 ⁶ PSi)	2,0	1,5	1,4	1,6
Ultimate Bearing Strength (PSi)	30.000	---	---	---

6.2.2.1.4 Accelerating weathering test

The material shall be submitted to an accelerating weathering test with a xenon-arc-type device for 1000 hours according to ANSI 14.5 § 7.9.5.1 (3). After the test, shall be evaluated the changes in fiberglass surface appearance (factor 8), in apparent color (factor 5), in gloss lost (factor 1) as follows:

Degree of Change	Rating
None	0
Trace	1
Slight	2
Medium	3
Heavy	4
Severe	5

The test shall be satisfactory if the sum of the products that come from the multiplications of the factor by the rating, is less than 35. Besides, the mechanical properties of the ladder, after the accelerating weathering test, shall comply with the table 1.

6.2.2.1.5 Dielectric strength

The material shall have a dielectric strength of 25 kV when tested according to ASTM D 149- 91.

6.2.2.2 Complete ladder's tests

6.2.2.2.1 Bending test of the ladder (EN 13 1-2 § 4.3)

The test shall be carried out on the complete ladder, as it is shown in fig. 2.

A pre-load of 100N shall be applied for the duration of one minute. The position of the ladder after removal of the pre-load is the origin for measurement. A test load F of 750N shall be applied vertically on the centre of the ladder for a duration of at least one minute. Thereby the maximum permissible deflection fmax. as a function of the distance l between the supports shall be less than $5l^2 \times 10^{-6}$ in mm. The test shall be performed in the direction of use of the ladder.

6.2.2.2.2 Lateral deflection test of the ladder (EN 131-2 § 4.4)

This Test shall be conducted on each part of the ladder.

The ladder shall be placed in lateral position, as it is shown in fig.3.

A pre-load of 100N shall be applied for the duration of one minute. The position of the ladder after removal of the pre-load is the origin for measurement.

A load F of 250N shall be applied to the lower stile equidistant from the supports. The deflection is measured equidistant from the supports one minute after loading. Thereby the maximum permissible deflection f_{max} as a function of the distance l between the supports shall be $f_{max} = 0,005 l$ in mm.

6.2.2.2.3 Bending test of rungs (EN 131-2 § 4.6)

A pre-load of 200N shall be applied for the duration of one minute. The position of the rung after removal of the pre-load is the origin for measurement (fig.4).

In the position of use of the ladder a test load F of 2600N shall be applied vertically on the midpoint of the weakest rung of any design evenly distributed over a width of 100mm and for the duration of one minute.

The maximum permanent deformation after removal of the test-load shall be 0,5% of the inner width of the step.

6.2.2.2.4 Test for locking devices (EN131-2 § 4.9)

The ladder is extended by at least one rung distance and placed in a vertical position as it is shown in fig. 5.

A uniformly distributed test load F of 3500N shall be applied vertically to the upper part of the ladder for a period of one minute. After removal of the test load, there shall be no permanent distortion in hooks or locking devices, or in their fittings, or the stiles or rungs.

6.2.2.2.5 Test of opening restraint device of self-supporting ladder (EN131-2 §4.8.)

For this test each leg of the ladder in the working position is placed on a platform provided with rollers (fig.6).

The test load F of 2600N is divided into two loads of 1300N, distributed over 2 x 100 mm each to be applied to the uppermost rung or step of the ascending leg as close as possible to the stiles for a duration of one minute.

After removal of the test loads, no visible permanent deformation shall occur on the hinge joints, opening restraint devices and their attachments.

The ladder shall not show any visible damages such as cracks, indentations etc. Permanent deformation is acceptable only if it does not impair the fitness for use of the ladder.

6.2.2.2.6. Strength test of the ladder (EN 131 - 2 § 4.2)

The test shall be carried out on the complete ladder, as it is shown in fig. 7. A pre - load of 500N shall be applied for duration of one minute. The position of the ladder after removal of the pre-load is the origin for measurement.

A test load F of 1000N shall be applied for a duration of one minute. The measurement shall be taken one minute after removal of the test load. The permanent deformation F of the ladder must not exceed 1‰ of the distance l between the supports.

6.2.2.2.7 Test method of the bottom stile ends (EN 131 - 2, § 4.5)

The ladder is to be placed with the lower stile in a horizontal position, as it is shown in fig. 8. A load block, 50mm wide, shall rest on the stile and shall effect the whole width of the stile. To be able to obtain a good rest against the stile it is permitted to cut off a part of a rubber foot, if

any. The lateral deflection of the stile end is measured at the foot of the ladder. A vertical force F of 900N is placed in the middle of the load block and is maintained for one minute. The permanent deflection after removal of the test load together with damages, if any, are reported.

As a variation the test can also be conducted after the inversion of the ladder.

The permanent deflection (change of dimension l) must not exceed 2mm. Neither fractures nor visible cracks are allowed.

6.2.2.2.8 Torsion test of steps (EN 131 - 2 § 4.7)

A torque M of 50 Nm shall be applied on the mid-point of the step via a 100mm wide clamping device.

The torque shall be applied alternately 10 times in clockwise and 10 times in counter-clockwise direction for a period of 10 seconds each. During testing there shall be no relative movement

in the connection between stile and step. After the test a permanent deformation shall be + 1° at maximum.

6.2.2.2.9 Repeated stile loading tests (ANSI 14.5 § 8.7.2.2)

The base section of the ladder shall be placed in such a position, so that the one stile to be fixed steadily and a force applicator to be clamped to the unsupported stile. This loading device shall develop a bending moment of 0,18 Kpm (4.800 pi). The relative movement of the two stiles shall not exceed a total excursion of 18 mm. The ladder shall be subjected to 10.000 cycles at a frequency of 10-15 cycles/min, without any evidence of test failure.

6.2.2.3. Test of metal parts.

The metal parts shall be submitted to the following tests:

- A supersonic test for the detection of possible defects.
- A Chemical analysis.

6.2.2.4. Anti-slip Cup tests.

The neopren shall be submitted to Chemical analysis.

6.3. Sample tests

All the type tests shall be done, so as the first production lot to be acceptable. As far as the following production lots are concerned, all the type tests or part of them shall be repeated, in the inspectors' judgment. The visual test as well as the hardness test of the material are necessary.

6.4. Routine tests.

The locking device test is carried out according to 6.2.2.4.

7. LABELING-MARKING

Each ladder shall be clearly and permanently marked with the followings:

- The IPTO's initials.
- The manufacturer's firm
- The date of manufacture (at least month and year).
- The contract number
- The indication 2x2.40m
- The indication: <<Maximum working load 140Kgr>> (on the first rung).

There will also be a self-sticking label with information according EN 131.

8. PACKAGE

Each ladder shall be packed in a plastic packing.

9. SAMPLES AND INFORMATION SUBMITTED WITH THE OFFER

Each supplier shall submit with his offer:

- A ladder similar or somewhat similar to the specified one, to the unit that IPTO will define so as IPTO to form a complete opinion about the ladder that is offered. IPTO, if it is worthwhile, shall demand the valuation of the supplier's manufacturing capability.
- Materials' manufacturing designs.
- Certificates