

# **DS/EN 1993-1-10 DK NA:2019**

## **National Annex to Eurocode 3: Design of steel structures – Part 1-10: Material toughness and through-thickness proper- ties**

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### **Foreword**

This National Annex (NA) is a revision of DS/EN 1993-1-10 DK NA:2011 and replaces the latter as from 2019-09-09. For a transition period until 2019-12-31, this National Annex as well as the previous National Annex will be applicable.

The changes in the revision are of an editorial nature only.

Previous, valid versions of the NAs as well as addenda to these can be found at [www.eurocodes.dk](http://www.eurocodes.dk).

This NA lays down the conditions for the implementation in Denmark of EN 1993-1-10 for construction works in conformity with the Danish Building Regulations.

A National Annex contains national provisions, viz. nationally applicable values, or selected methods. The Annex may furthermore provide non-contradictory, complementary information.

This NA includes:

- an overview of possible national choices and clauses containing complementary information;
- national choices;
- non-contradictory complementary information.

## Overview of possible national choices and complementary information

The list below identifies the clauses where national choices are possible and the applicable/not applicable informative annexes. Furthermore, clauses giving complementary information are identified. Complementary information is given at the end of this National Annex.

Clause	Subject	National choice <sup>1)</sup>	Complementary information
2.2(5) Note 1	Selection of materials for fracture toughness - Procedure	Unchanged	
2.2(5) Note 2	Selection of materials for fracture toughness – Procedure		Complementary information
2.2(5) Note 3	Selection of materials for fracture toughness – Procedure	National choice	
2.2(5) Note 4	Selection of materials for fracture toughness – Procedure	No choice made	
3.1(1)	Selection of materials for through-thickness properties - General	Unchanged	
3.2(2)	Procedure		Complementary information
<sup>1)</sup> <i>Unchanged:</i> Recommendations in the Eurocode to be followed. <i>National choice:</i> A national choice has been made. <i>No choice made:</i> No national choice has been made. The Eurocode does not recommend values or methods but allows the option of determining national values or methods. <i>No further information:</i> The Eurocode allows for further information – no additional information is given. <i>Not relevant for building structures:</i> See the National Annexes published by the National Road Directorate and Banedanmark. <i>Not applicable:</i> The Annex is not applicable. <i>Applicable:</i> The Annex is applicable in Denmark and has status as normative. <i>Complementary information:</i> Additional guidance on how to use the Eurocode.			

## **National choices**

### **2.2(5) Note 3 Selection of materials for fracture toughness - Procedure**

The following shall be observed for structures subject to fatigue:

$$T_{md} + \Delta T_r \geq T_{27J} - 40 \text{ } ^\circ\text{C}.$$

## Non-contradictory, complementary information.

### 2.2(5) Note 2 Selection of materials for fracture toughness - Procedure

The following values of  $\Delta T_{\sigma}$  may be assumed when using the tabulated values according to 2.3.

$\Delta T_{\sigma} = +30$  °C for rolled sections

$\Delta T_{\sigma} = +15$  °C for sections with drilled holes

$\Delta T_{\sigma} = -15$  °C for transverse butt welds subject to considerable loading.

### 2.3.1(2) General

The text of expressions (2.3) and (2.4) gives information on how to deduct the numerical values  $\Delta T_{\varepsilon}$  and  $\Delta T_{\varepsilon_{cf}}$  from the expression (2.2) to reduce the value of  $T_{Ed}$ .

This is specified as follows:

$$T_{Ed} = T_{md} + \Delta T_r + \Delta T_{\sigma} + \Delta T_R - \Delta T_{\varepsilon} - \Delta T_{\varepsilon_{cf}}$$

where

$$\Delta T_{\varepsilon} = \frac{1440 - f_y(t)}{550} \times \left( \ln \frac{\dot{\varepsilon}}{\dot{\varepsilon}_0} \right)^{1,5} \text{ [}^{\circ}\text{C]}$$

$$\Delta T_{\varepsilon_{cf}} = 3 \times \varepsilon_{cf} \text{ [}^{\circ}\text{C]}$$

### 3.2(2) Procedure

The following designations are used:

- Z stress:  
plate or section subjected to through-thickness stress
- UT:  
testing for laminar imperfections of plate or section

A: For Z stressed plates/sections with estimated  $Z_{Ed} > 30$  (DS/EN 1993-1-10, equation 3.2 and Table 3.2), Z testing to Z35 according to EN 10164 is required.

UT testing for laminar imperfections of Z stressed plate or section surface is required within a distance of 100 mm from the weld. If  $S \leq 0,005$  % for current charge, the extent of UT testing may be reduced to sampling tests (5-10 % of weld length).

B: For Z stressed plates/sections with estimated  $Z_{Ed} \leq 30$  (DS/EN 1993-1-10, equation 3.2 and Table 3.2), Z testing with acceptance criteria  $Z_{Rd}$  is required according to EN 1993-1-1, clause 3.2.4, Table 3.2.

UT testing for laminar imperfections of Z stressed plate or section surface is required within a distance of 100 mm from the weld if:

Z stressed plate thickness  $> 25$  mm

or

Throat thickness of fillet weld / or partial penetration T-butt weld  $> 10$  mm

or

Distance of welded joint to free edge of Z stressed plate  $< \frac{1}{2}$  plate thickness of Z stressed plate.

If Z stressed plate/section has been supplied with UT testing according to EN 10160 class S2/E3 or EN 10306 class 2.4 or  $S \leq 0,005$  %, the extent of UT testing of plate or profile surface may be reduced to sample tests (5-10 % weld length).

C: For Z stressed plates/sections with estimated  $Z_{Ed} \leq 10$  (EN 1993-1-10, equation 3.2 and Table 3.2), Z testing is not required.

UT testing for laminar imperfections is only required if maximum utilization grade  $> 0.5$  of Z normal design tensile stress relative to the design yield strength  $f_{yd}$  in the centre surface of Z stressed plate/section/flange/web, where tensile stresses are assumed to be distributed evenly within  $45^\circ$ .

UT testing for laminar imperfections of Z stressed surface is carried out within a distance of 100 mm from the weld.

If Z stressed plate/section has been supplied with UT testing according to EN 10160 class S2/E3 or EN 10306 class 2.4 or  $S \leq 0,005$  %, there is no requirement for UT testing for laminar imperfections.

D: Z and UT testing for laminar imperfections are waived for structures in EXC1 for material S235 if the thicknesses in tee joints and cruciform joints are  $< 25$  mm or  $S \leq 0,005$  %. for Z stressed component.

General:

UT acceptance criterion according to EN 10160 class S2/E3 for plates and EN 10306 class 2.4 for open sections.

UT test is carried out after welding - and with a holding time after welding as stated in EN 1090-2, clause 12.4.2.1, Table 23. UT test is performed and documented according to the requirements of EN 1090-2 and EN 10160 or EN 10306.

The positions of UT testing for laminar imperfections are applied to drawings by the designer.

If - when determining  $Z_{Ed}$  according to EN 1993-1-10, Table 3.2 - preheating or low strength weld metal was used (Table 3.2, b and e), this shall be specified on drawings.

For preventive reasons, it is recommended to carry out UT testing for laminar imperfections of randomly chosen zones prior to welding.