E.10/5 : DESTRESSING OF RAILS

CONTENTS

1. SCOPE

This specification covers the work necessary for the destressing of rails in track.

2. INTERPRETATIONS

2.1 SUPPORTING SPECIFICATIONS

2.1.1 Where this specification is required for a project, the following specifications, shall, inter alia, form part of the contract documents:

a) The E.10 Gen - General.
b) The E.10/2 - Laying of sleepers.
b) The E.10/7 - Field welding of rail joints.
c) The E.10/11 - Survey and setting out of track alignment and referencing.

2.1.2 In addition the following specifications, inter alia, may be required:

a) The E.10/1 - Laying of rails.
b) The E.10/9 - Slewing and alignment.

2.2 DEFINITIONS

Void.

3. MATERIALS

Void.

4. PLANT

The Contractor may, at his own cost, make use of rail tensors when destressing rails.

5. CONSTRUCTION

5.1 GENERAL

Void.

5.2 SAFETY

Void.

5.3 PROGRAMME AND METHOD STATEMENT

Void.

5.4 METHODS AND PROCEDURES

5.4.1 Destressing may be performed by either the conventional method or by using rail tensors, both as specified hereinafter.

5.4.2 Destressing shall only be carried out when the Engineer is present.

5.4.3 Before destressing long welded rails, the Contractor shall ensure that -

i) The horizontal and vertical alignment of the track is within the B-standard and the track is otherwise within the A-standard;
ii) The weather conditions are favourable and that no sudden temperature changes which may prevent or interrupt destressing are foreseen;
iii) When tensors are used, the force necessary to pull the rail is within the capacity of the tensor; and
iv) When rollers are used, they are oiled and in a good working condition.

5.4.4 The destressing of long-welded rails by the conventional method shall be performed while the rail temperature is within the applicable temperature ranges given in Annexure H of specification E.10 Gen. Destressing with rail tensors may be performed when the rail temperature is below the abovementioned range but not below 0 °C.

5.4.5 Rail temperatures shall be measured by placing the thermometer on the crown of the rail and shading it from direct sunlight. The thermometer must remain in contact with the rail for at least ten minutes before it is read.

5.4.6 The Contractor shall have three track thermometers evenly spaced in continuous use during destressing. He shall record the following information:

i) The rail temperature at 15-minute intervals starting from one hour before the start of the work.
ii) The times that the first and last sleeper fastenings on each rail were fitted and fastened.
iii) The identity of each rail destressed.

5.4.7 DESTRESSING METHODS

5.4.7.1 The panel to be destressed shall not be longer than 500 metres.

5.4.7.2 Both rails shall be cut at the end of the section to be destressed and the rail ends shall be placed so that the rails can move freely. The rails shall remain connected at the beginning of the panel.

5.4.7.3 All sleeper fastenings in the panel shall be undone. The rails shall be raised slightly and placed on rollers so spaced that the rails do not touch the sleepers.

5.4.7.4 CONVENTIONAL METHOD

a) The rails shall be vibrated by vibrators or by hammer blows on both sides of the crown to overcome friction resistance. The sides of the bottom flange of the rails shall not be hit. Vibrating shall proceed from the beginning of the end of the panel.

b) Immediately behind the points vibrated, the rollers shall be removed and the rails fastened to at least every third sleeper.

c) All sleeper fastenings shall be fastened and the rail ends reconnected to the adjoining rails before the rail temperature goes outside the specified temperature range. If it is not possible to reconnect the rails by welding, fishplated joints with 4 fishbolts each shall be installed.

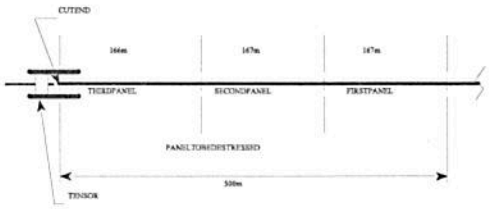
5.4.7.5 DESTRESSING WITH TENSORS

a) Rails that are wholly or partly in a curve of radius less than 800 m shall not be destressed with a tensor except on the written instructions of the Engineer, who will issue special directions about the manner in which the rails are to be kept in position during the application of stress with the tensor.

The following example is supplied to destress rails using the tensor.

Rail	60 kg/m
Rail Temperature	15°C
Destressing Temperature	35°C
Panel length	500 m

i) The panel is divided as follows:



ii) As a result of the friction, adjustments are made for the temperature at the panel furthest and nearest to the tensor (First panel and Third Panel). This method is theoretical and it will be indicated that differences are negligible.

The following adjustments must be made for temperature to compensate for friction.

$$\Delta t' = \frac{1.66 \times 0.1 \times \text{panel length in meter}}{\text{Rail mass per meter}}$$

iii) Calculate the extension of the rail:-

$\Delta 1 = \alpha \times \Delta t \times$ panel length

where

α = Temperature coefficient for steel.
Δt = Temperature difference is between rail temperature and destressing temperature.

iv) Calculate the force with which the rail must be pulled by the tensor.

$P = \alpha \times \Delta t \times E \times A$

where

α = Temperature coefficient for steel.
Δt = Temperature difference between rail temperature and the destressing temperature.
E = Youngs Modules for steel.
A = Cross sectional area of rail.

The following information is supplied for the calculations:-

α = 11.5×10^{-6} /°C for 48, 57, 60 kg/m rails
E = 209×10^{9} Pa for 48, 57, 60 kg/m rails
A = 60.18×10^{-4} m² 48 kg/m rail
73.24×10^{-4} m² 57 kg/m rail
77.02×10^{-4} m² S60 kg/m rail
76.86×10^{-4} m² UIC60 kg/m rail

v) Calculations for the First Panel.

For the First panel (167 m) the adjustment becomes.

$$\Delta t' = \frac{1.66 \times 0.1 \times 167}{60}$$

$\Delta t' = 0{,}462$°C

For the panel furthest from the tensor, $\Delta t'$ should be added to Δt. The rail must thus be lengthened by.

$\Delta 1 = \{11.5 \times 10^{-6} \times (35 - 15 + 0{,}462) \times 167\}$
$\Delta 1 = 39{,}3$ mm

The force which must be applied by the Tensor is:
$P = \{11.5 \times 10^{-6} \times (35 - 15 + 0{,}462) \times 209 \times 10^{9} \times 77.02 \times 10^{-4}\}$
$P = 37{,}9$ ton.

vi) Calculations for the Second Panel.

Here no adjustment for temperature is made to compensate for friction.

thus

$\Delta 1 = \{11.5 \times 10^{-6} \times (35 - 15) \times 167\}$
$\Delta 1 = 38.4$ mm

$P = \{11.5 \times 10^{-6} \times (35 - 15) \times 209 \times 10^{9} \times 77.02 \times 10^{-4}\}$
$P = 37{,}0$ ton.

vii) Calculations for the Third panel.

Here the adjustment of temperature to compensate for friction is deducted:-

thus

$$\Delta t' = \frac{1.66 \times 0.1 \times 166}{60}$$

$\Delta t' = 0{,}459$ °C

$\Delta 1 = \{11.5 \times 10^{-6} \times (35 - 15 - 0{,}459) \times 166\}$
$\Delta 1 = 37.3$ mm.

$P = \{11.5 \times 10^{-6} \times (35 - 15 - 0.46) \times 209 \times 10^{9} \times 77.02 \times 10^{-4}\}$
$P = 36{,}2$ ton.

viii) If friction is ignored and the calculations repeated, the average difference in force is 0.8 ton over the 500 m length which has basically no influence on long welded rails.

ix) To make the analysis easier the following calculations can be made:-

$\Delta 1 = 11.5 \times 10^{-6} \times (35 - 15) \times 500$
$\Delta 1 = 115$ mm

$P = 11.5 \times 10^{-6} \times (35 - 15) \times 209 \times 10^{9} \times 77{,}02 \times 10^{-4}$
$P = 36{,}0$ ton

The extension is divided into three (three panels) which gives a value of 38 mm (rounded off). Thus the first panel must be lengthened by 38 mm, the second panel by 38 x 2, that is 72 mm and the third panel by 38 x 3, that is 114 mm. Since the lengthening of the rail is the most important in the whole action, it will be necessary for the force of the Tensor to change to obtain the desired extension.

b) The panel to be destressed shall be measured and the third points thereof determined. The one third portion of the panel closest to the beginning of the panel will be referred to as the first portion of the panel, the middle one third portion will be referred to as the second portion and the end portion will be referred to as the third portion. The end of each portion shall be taken as that side of the portion closest to the end of the panel where the rails have been cut and where the tensor will be applied.

c) After a rail is loosened and placed on rollers, marks shall be made on those sleepers closest to the ends of each portion. Corresponding marks shall be made on the flange of the rail so that the longitudinal movement of the rail can be measured during application of the tensor. The required movement at each mark shall be calculated as described above.

d) The tensor force shall thereafter be adjusted until the correct movement is obtained at the end of the second portion, whereafter the rollers shall be removed from underneath that portion and the rail fastened to every second sleeper within that portion.

e) The procedure described in (d) above shall be repeated for the third portion, whereafter the rail shall be welded to the adjoining rail. After the joint has cooled down, the tensor shall be removed.

5.4.8 To ensure that there is no differential stress between the two rails of a track, the Contractor shall, when destressing or laying rails within the destressing rail temperature range, fit the sleeper fastenings of the left and right rails simultaneously on each sleeper.

5.4.9 The Contractor shall renew any damaged sleeper fastenings and shall replace any which are missing.

5.4.10 The forms in the Project Specification for recording details of the destressing shall be filled in and handed over to the Engineer.

5.5 STANDARDS

Void.

5.6 COMPLETION

Void.

6. TOLERANCES

Void.

7. TESTING

The Contractor shall get the Engineer's certification of all records listed in clause 5.4.6.

8. MEASUREMENT AND PAYMENT

8.1 SCHEDULED ITEMS

8.1.1 Renew damaged and replace missing sleeper fastenings ..... Unit: Each

All renewed and replaced sleeper fastenings will be counted.

8.1.1.1 Separate items will be scheduled for the following:

Different type of sleeper fastenings.

8.1.1.2 The rates tendered shall include for the following:

a) Removing of damaged sleeper fastenings.
b) Fitting of new sleeper fastenings.

8.1.2 Destress track..... Unit: m or km rail

The length of track destressed will be measured along the centre line of the track.

8.1.2.1 Separate items will be scheduled for the following:

a) Standard of track.
b) Existing track.
c) New track.

8.1.2.2 The rates tendered shall include for the following:

a) Measuring the rail temperatures.
b) Loosening, destressing and refastening both rails as specified.

8.1.2.3 No additional payment will be made for the use of rail tensors.