

## SURFACING OF FROG CORE

D.Sergejevs, S.Mihailovs

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Every year a great number of cores and rail wings with vertical and lateral wears are detected on Latvian Railway. These damaged cores and rail wings disturb smoothness of train movement, create danger for safe railway traffic and necessitate slowing down speed in the case of evolution of wears which consequently leads to higher purchase costs for replacement of faulty switch elements with new once.

The value of wear  $\Delta N$  is usually estimated on layer thickness  $\Delta h$ , volume  $\Delta V$  or mass of material  $\Delta M$  taken away from a friction area. The most popular characteristic of the wear process is  $I$ , which represents the ratio of the wear  $\Delta N$  to the distance  $\Delta S$  or to the volume of work  $\Delta A$  where the wear process occurred 1:

$$I = \Delta N / \Delta S \quad , \quad I = \Delta N / \Delta A \quad (1)$$

The process of wear is evaluated in terms of non-dimensional quantity of the linear wear rate  $I_h$  which is the first derivative of the thickness  $\Delta h$  of the damaged layer with respect to the friction distance  $\Delta S$  performed 1:

$$I_h = \Delta h / \Delta S \quad (2)$$

The process of wear comprises three stages: surfaces interaction, change of surface layer and surface failure. It is known that the rate of wear for the same bodies may increase or decrease tens or even hundreds times at apparently insignificant fluctuations of environment parameters, e.g. humidity or temperature elevation.

On Latvian Railway, on the basis of innovative technology, repair of damaged cores and rail wings is carried out without their removal from switches.

To surfacing are subject frogs, in which vertical wear of cores and rail wings reached 3 mm. Previous to frog surfacing, it is necessary to determine what material it is made from.

Dimensions of the frog profile and supposed surfacing area are determined using frog templates. The results of measurement are marked on the rail base.

The core and the wearable part of a rail wing are made of high-manganese steel with the manganese content of 12-14% and are surfaced without preliminary heating. Since properties of high-manganese steel degrade at temperatures from +200°C to 700°C and there is a risk of crack formation in surfacing area, no frog heating above +200°C can be allowed by no means.

The above cores surfacing should be as far as possible carried out at low ambient temperatures. Thus a risk to overheat high-manganese steel would be less.

Damaged material is removed from core and wearable parts of rail wings by grinding. The total area of surfacing should be grinded evenly as far as possible.

After “colored testing” a drying of high-manganese steel is carried out by warming-up to +50 - +60°C using propane torch reducing thus a possibility of pockets formation during welding.

Surfacing should be carried out using electrode OK 86.28 4.0 – 5.0 mm of diameter by short welds till 100 mm of length which gives a minimum heat to a core. Each surfaced weld should be forged using hammer of 500 g of weight in order to avoid shrinkage cracking.

A core temperature should be tested during surfacing using a digital thermometer. In the case when the temperature is close to +200°C, the work should be suspended to cool down a core to +130 - +140°C.

The determined sequence of making the welds should be observed during surfacing.

The initial and final weld craters should be superimposed on the frame welds which are non-active materials and are totally removed by grinding after the surfacing has been completed. In the rest of cases the initial and final weld craters should be carefully grinded before proceeding with the next welds superimposing.

The repair of a switch core is shown in Fig. 1. A rail wing should be surfaced using the same principle.

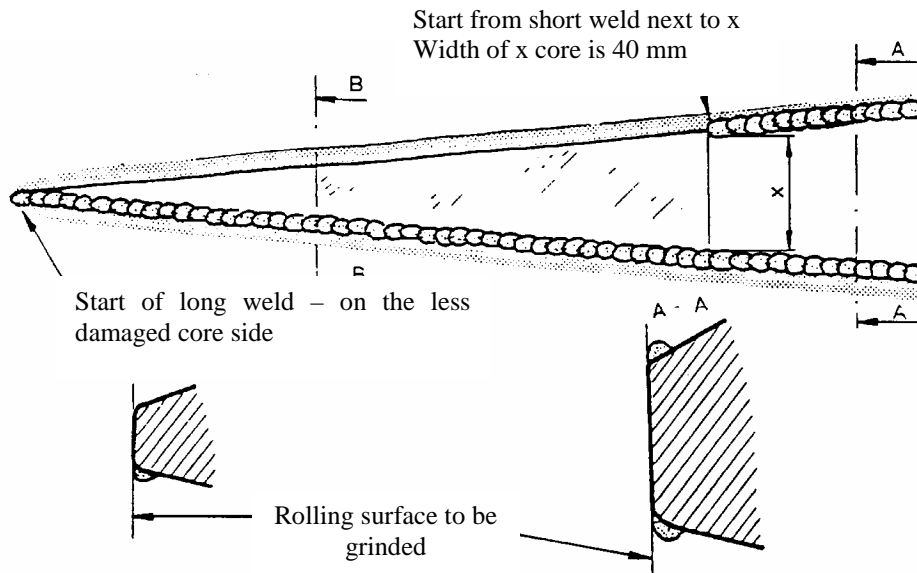


Fig.1. Frame welds surfacing.

On the beginning and finishing three welds are surfaced on frame welds transverse to the point (see Fig.2). Outside weld surface to be grinded at an angle of  $45^\circ$ .

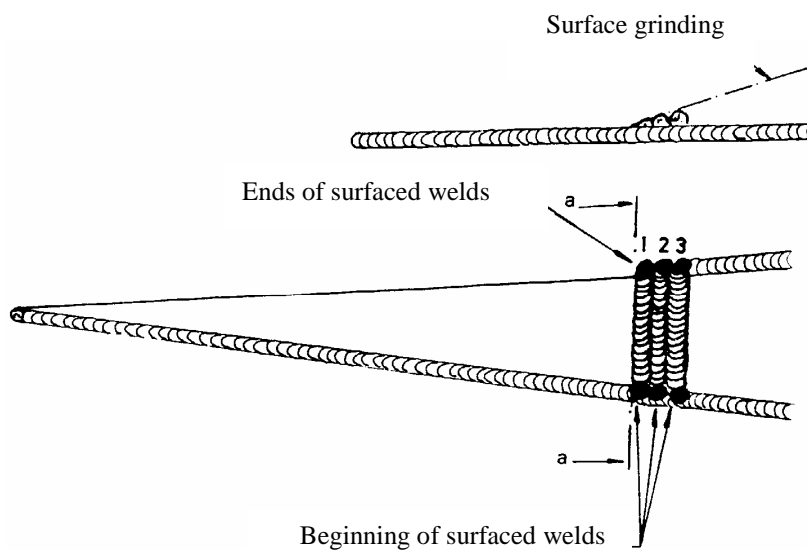


Fig.2. Surfacing of transversal welds

Then welds of 100 mm of length are surfaced parallel to any of working side of the core ending on the transversal welds (see Fig.3).

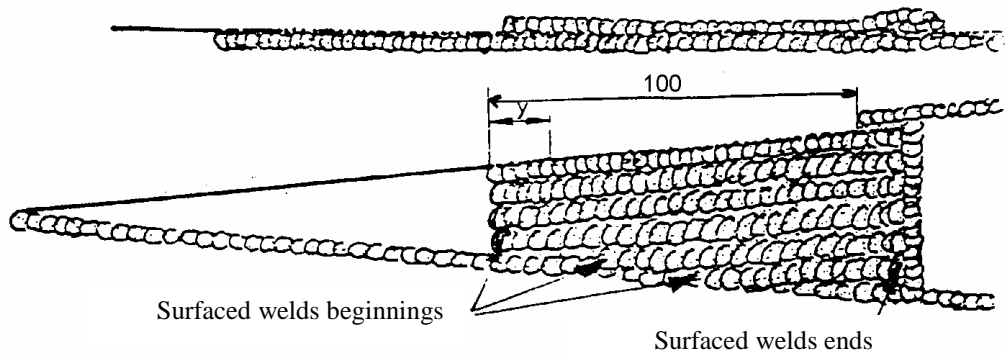


Fig.3. Longitudinal welds surfacing

Thus the surfacing of the longitudinal welds along the working side of the core continues (see Fig.4)

Don't forget to control the working temperature of the core during the repair.

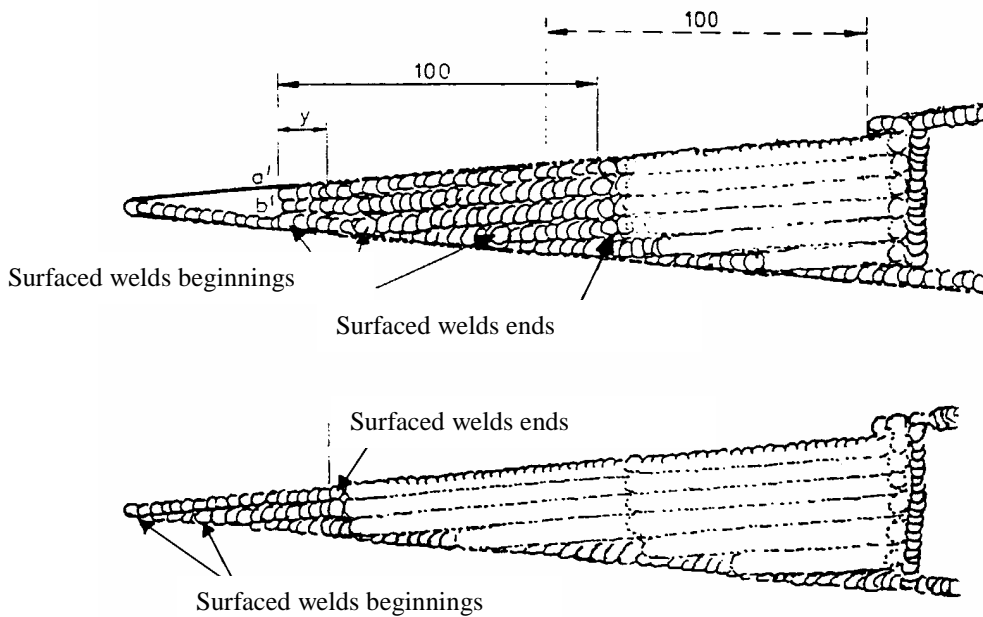


Fig.4. Longitudinal welds surfacing

When the fore-part of the point is completed, the surfacing with transversal welds is proceeded, starting and finishing on the frame welds, as shown on Fig.5.

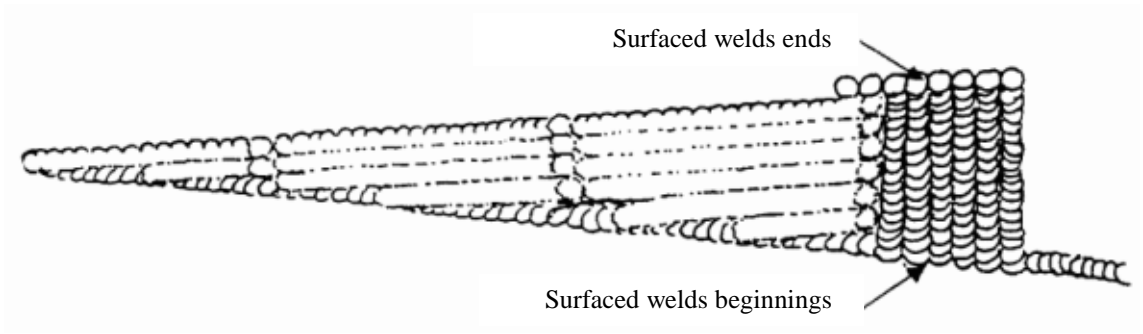


Fig.5. Surfacing of transversal welds

The same principle is used to proceed with surfacing to the necessary height of the surfaced area.

Immediately on completion of the surfacing, a rolling surface should be grinded to an approximate level and profile. A surfaced material is left for fine grinding.

When the core cools down to +30 - +40oC, a final polishing is carried out to the designed profile.

The grinding is carried out using a grinder type “ROBEL” for switches as well as polishing tools. The heating of the core at grinding should not be above +70oC in order to avoid a temperature strain which may lead to its incorrect geometry.

The control measurements are taken using templates.

As it was proved by experience, on the completion of each 30 cm sector surfacing, the rail can be grinded without a necessity to be cooled down.

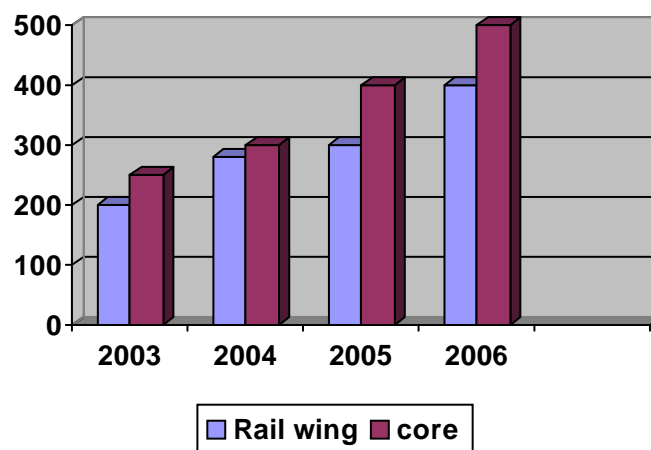


Fig.6. Quantity of cores and rail wings surfaced on Latvian Railway

The ultrasonic testing of the frame rail in the place of repair is carried out in the course of 1 – 7 days after the surfacing has been completed, drawing up a corresponding statement. For the time of surfacing in the field conditions the switch should be closed for train operation.

### **Conclusions:**

- the quality of surfaced layer on the average meets the requirements, does not disturb a smoothness of train movement and does not create danger for the safe traffic provided the technology of switch cores surfacing has been strictly observed;
- according to the calculations, frog core surfacing economically is more advantageous than its replacement with a new one;
- the supervisions of frog cores surfacing on Latvian Railway confirm its effectiveness with respect to the increment of the intervals between maintenances of switches, which provides for lower purchase costs required to replace faulty switch elements with new once.

### **REFERENCES**

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