Non-contact wire measurement

The inspection of the current height and stagger of the contact wire is important for the system safety and train operation when installing new overhead contact wire systems or for maintenance during operation.

Since the times available for service work on contact wires are increasingly shorter, fast measurement of the contact wire position is very important for time reasons and therefore for cost reasons. It is also desirable to obtain a report in which the current position of the contact wire is shown in relation to the position foreseen in the system planning and is compared directly with the limits and tolerances permissible for the line type. Measurement of the contact wire position should be possible with and without uplift according to specifications.

The OVHWizard System presented below fulfils all these functions with a good price/performance ratio.

1 Measuring system and installation

The OVHWizard® is a mobile, non-contact operating contact wire position measuring system. The device operates with ultrasound according to the principle of runtime measurement. This measuring principle offers the advantage over optically operating systems that it can also work in direct sunlight, light rain or fog. The ultrasonic sensors positioned at the ends of the measuring system transmit ultrasound pulses which are reflected by the contact wire and can be received again by the sensor. The runtime that corresponds to a distance signal supplies the position of the contact wire with height and stagger at the point of intersection of the two distance values. Fig.1 shows the measuring system installed on a road-rail vehicle.

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The non-contact measurement can be made on a live contact wire. If the measuring vehicle has a measuring pantograph with adjustable force, e.g. 100 N, the contact wire uplift can be measured. Both measurements - one on top of the other - supply the elasticity and non-evenness.

The OVHWizard® weighs only approximately 4 kg and is therefore easy to transport and is ready for operation in short time. An RS232 connecting cable to the notebook establishes the online communication with the measuring software. Integrated batteries or an external power supply unit supply the power to the OVHWizard® . A pulse generator consisting of a light barrier and self-adhesive reflector for sticking to the wheel supplies the distance signals to the measuring system. There is also an optional possibility of using an existing distance measurement on the vehicle by an encoder installed in the vehicle. The OVHWizard® software processes the measured data, saves them and enables a graphic or tabular display. With the additional FMA software the user can perform an exact evaluation of the measurement runs in comparison with the specified nominal data on site immediately after the measurement.

Thanks to its compact design the system can be installed on different carrier vehicles, e.g. a rail trolley, a road-rail vehicle or a railway vehicle.

The rail trolley as a carrier vehicle can be transported to the measuring line quickly in a car trailer. Its rigid structure without any suspension makes compensation of the rolling superfluous. The rail trolley offers the advantage that the measurement is independent of the contact wire installation or maintenance and inspection vehicles with a working platform are therefore available for other work.

Road-rail vehicles offer the combination of a mobile measuring vehicle and installation vehicles and can reach the application site quickly. Together with the OVHWizard® measuring system it can be used on the working site as an installation vehicle or as a measuring vehicle. However, the road-rail vehicle needs a compensation device because of its sway if it is not possible to block the suspension.

On electric-driven railway vehicles the OVHWizard® is usually installed near to the pantograph. This enables non-contact measurement and measurement of the contact wire uplift when the pantograph is used. Although the vehicle cannot be used for other work during the measurement, it offers the possibility of immediate evaluation and performing of correction work.

Fig. 1: The OVHWizard measuring system on a road-rail vehicle

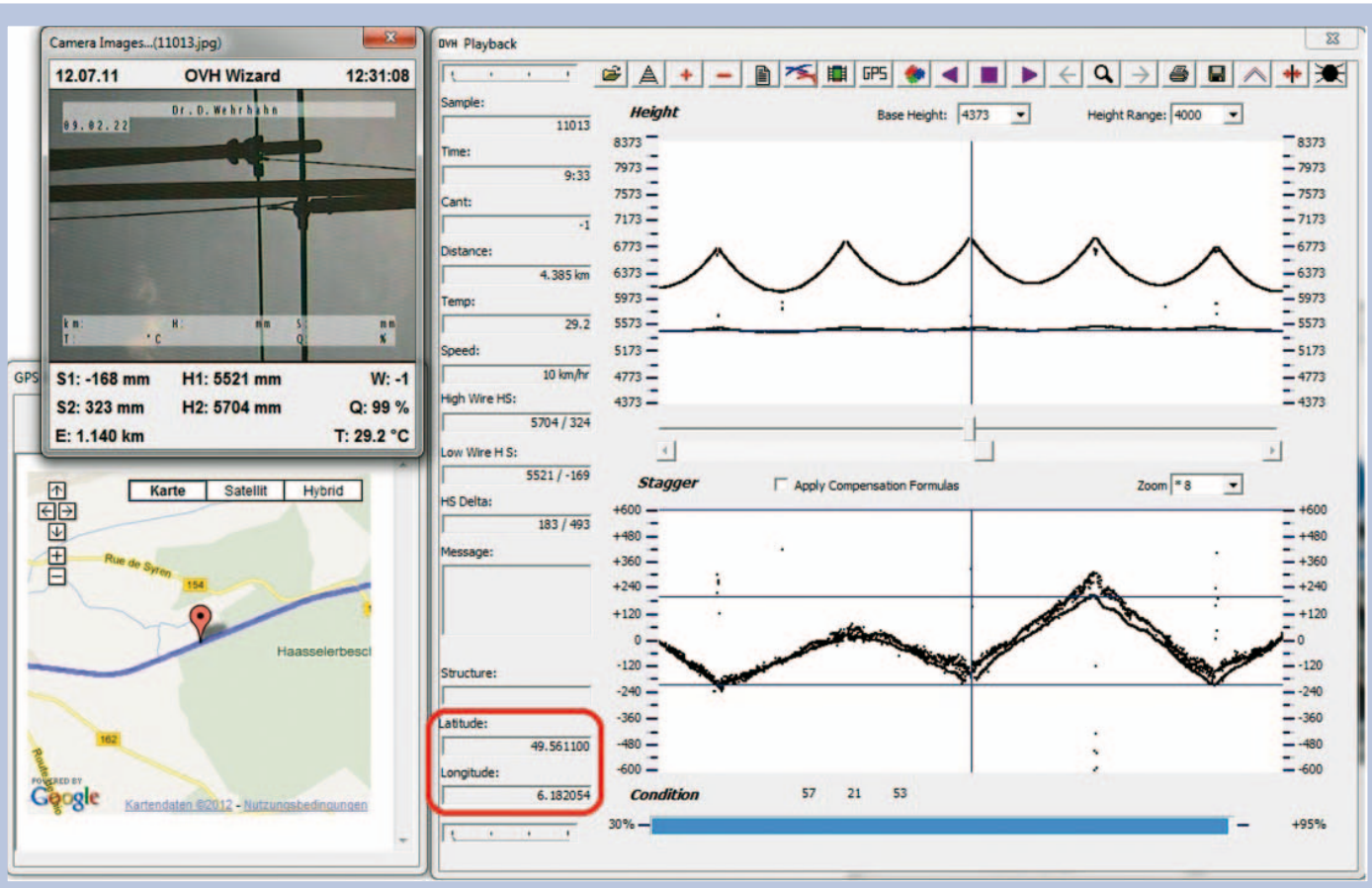


Fig. 2: Graphic display of the measurement

2 Measuring result and evaluation

The average deviation in the non-contact height measurement of the contact wire rest position without the external influence of the carrier vehicle is about +/−2 mm. This corresponds to the simple standard deviation. The measured data are measured equidistantly at pre-selectable distances depending on the vehicle speed. The measuring distance should not exceed 50 mm for measurements of the contact wire position. This allows the dropper positions to be checked within the given position tolerance.

Since the OVHWizard System is connected directly to the carrier vehicle, movements of the vehicle relative to the contact wire lead to errors. The following vehicle movements occur here as errors:

- ▷ lateral movement of the vehicle due to the transverse play between wheel set and track
- ▷ change in height of the vehicle due to the suspension
- ▷ inclination of the vehicle due to different response of the vehicle suspension to dynamic influences during travel

These three influential variables usually do not occur alone but in combination with each other. These influences can largely be compensated by using additional ultrasonic or laser sensors under the vehicle.

The evaluation can be done online or offline. The online software of the OVHWizard System already displays the evaluated height and stagger of the contact wire during the measurement. The compensated measured data are also displayed immediately if compensation is installed in the measuring vehicle. If an optionally available roof camera was installed, the video picture of the measuring point is shown in parallel to the measurement. This often simplifies the interpretation of the measuring results in the displayed online graphic (Fig. 2).

After measuring and saving the measured data, an extensive evaluation can be carried out using the FMA software (contact wire measured data analysis).The FMA software offers the possibility of collecting and checking the specified line data (basic data) such as pole position, dropper position and rail position. In addition the standard designs can be stored. The tolerances, the permissible wind deflection and other variables to be checked are defined in the standard designs under consideration of the permissible speed.

The FMA software also offers the possibility of detailed reporting according to specifications delivered by Deutsche Bahn (DB). All the basic data of the measurement (place, direction, measuring vehicle, temperature etc.) are listed in this report and it is possible to check every measurement position against the given tolerances. These values are listed both in table form down to the single dropper and also graphically in the second part of the report (Fig. 3).

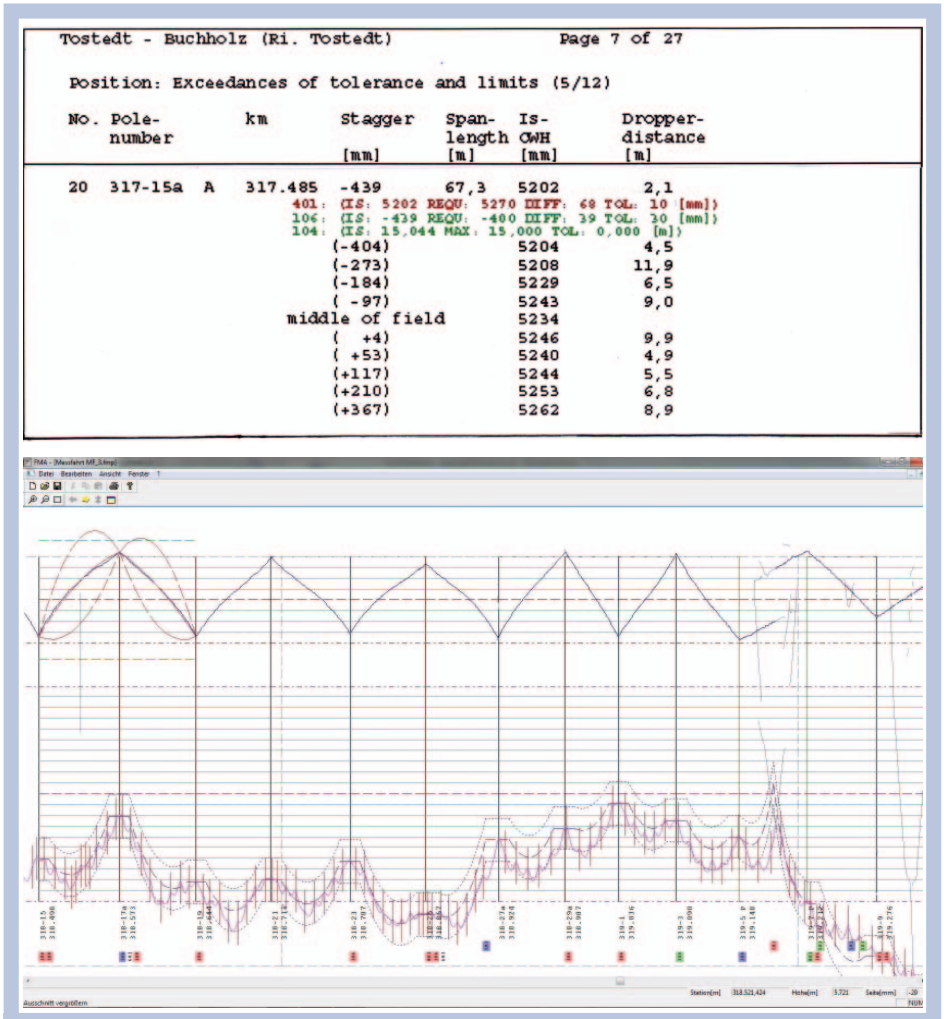
The program finally offers a list of all the positions to be corrected with kilometre position and height and/or stagger values to be corrected for service.

3 System extensions

The OVHWizard system can be extended by the following components.

Vehicle compensation

If the suspension in the respective measuring vehicle cannot be blocked for the measurement run, the vehicle movements will cause measuring errors. Compensation of the vehicle movements is necessary depending on the accuracy demanded from



Tostedt - Buchholz (Ri. Tostedt) Page 7 of 27

Position: Exceedances of tolerance and limits (5/12)

No.	Pole-number	km	Stagger [mm]	Span-length [m]	Is-OWH [mm]	Dropper-distance [m]
20	317-15a A	317.485	-439	67,3	5202	2,1
			401: (IS: 5202 REQU: 5270 DIFF: 68 TOL: 10 [mm])			
			106: (IS: -439 REQU: -400 DIFF: 39 TOL: 30 [mm])			
			104: (IS: 15,044 MAX: 15,000 TOL: 0,000 [m])			
			(-404)		5204	4,5
			(-273)		5208	11,9
			(-184)		5229	6,5
			(-97)		5243	9,0
			middle of field		5234	
			(+4)		5246	9,9
			(+53)		5240	4,9
			(+117)		5244	5,5
			(+210)		5253	6,8
			(+367)		5262	8,9

Fig. 3: List of measured values in the FMA report and graphical preview of the height and stagger in the FMA with tolerance band

the measurement. This can be provided as an option but must be designed individually for every vehicle type.

Railway-compatible roof camera

With the installation of the available roof camera, a picture is taken for every measurement. The pictures run as a video film for the measured data in the online observation or later analysis. The measured values determined for height and stagger, kilometres travelled and temperature are displayed online for every measurement. This enables pictures of individual points at which deviations occurred to be sent directly to the responsible service departments later.

Measuring the pole positions

If a roof camera is installed, the pole position can be determined based on an image evaluation of the camera pictures with the accuracy of the set measuring distance (min. 100 mm). These data can also be read into the FMA software as basic data if the basic data are missing.

GPS tracking

The system can be equipped optionally with an additional GPS receiver. This enables you to track the travelled stretch in Google Earth or other available GPS map material during later observation of the measurements. The GPS function is only used for optical display and not for measuring the current distance travelled because this is too inaccurate with the minimum required measuring distances of 100 mm per measuring point (DB approval).

Measuring the lateral pole distances

By additionally installing two laser sensors, it is possible to determine the lateral pole distances from the centre of the rail together with the contact wire position measurement. Two laser sensors are used so that poles positioned both to the left and right of the rail can be measured.

4 Approval of the OVHWizard system

The system can only be approved together with a vehicle. For this, the system must be presented to the respective certification body and the measuring accuracy must be proven in relation to a manual measurement with an approved manual measuring instrument.

The OVHWizard is currently approved in Germany (DB), Austria (ÖBB), Switzerland (SBB), Luxembourg (CFL) and Turkey (TCCD).