Photo-optical timber measurement, Certified by the German State!
Trade your timber at the forest road.

In recent years, the users of photo-optical systems and their customers have been demanding certification with increasing intensity. What are the consequences of the verification of certification-capability, and what form do the legal framework conditions and test requirements take?

The first three sScale™ systems from Dralle A/S positively completed a "conformity evaluation process" in accordance with German measurement and calibration law at the end of January 2016. For years, sScale™ has been used to measure millions of cubic metres, and the first systems can now be used for timber sales right away.

Consequences of Certified timber measurement

With fundamental verification of the Certification-capability of sScale™ as a photo-optical wood stack measurement system and the first three conformity evaluations of individual devices, Dralle A/S is able to offer the forestry and timber sector legally assured, precise and transparent timber measurement from 2016.

The photo-optical wood stack measurement should now consistently also take place on an RVR-compliant (rules for timber trading in Germany) basis by means of the Certified front area measurement with sScale™, in accordance with the calculation-relevant measurement process cited in 5.2.

sScale™ is conformity-evaluated as a single device in the category "photo-optical area measurement device". The measurement variable is the wood stack front area with a maximum error margin of +/- 3%. Multiplied by a defined order length, it is possible to derive a bundle volume - the cubic measure - for wood stacks. On the basis of the conformity-evaluated measurement variable, it is possible to determine other commercially relevant wood stack characteristic values through further defined calculations - e.g. contractually-regulated conversion factors, volume excesses or other correction factors. These sales-relevant "target variables" are then based on a conformity-evaluated measurement variable, although they themselves are not conformity evaluated and part of the contractual regulations of timber vendors and buyers. Approaches for deriving target variables are provided for example by RVR.

In Germany, sScale™ has already proven itself in the measurement of many millions of cubic metres in everyday forestry work, and can now be employed by users as a central instrument for all application fields encompassing wood stack data management. The automated integration of wood stack data in the customer's own data processing systems here results in the significant simplification of work and quality enhancement in provision, marketing and logistics processes, with corresponding cost savings through process acceleration.

Timber vendors and buyers should mutually discuss appropriate integration possibilities of sScale™ in the commercial process of timber marketing, and determine contractual regulations that are practical for both parties.

Timber vendors and buyers alike can utilise sScale™ as a measurement and timber stack data management system, and profit from the process-enhancing aspects. Supplementary external measurement and data provision as part of service provided by a third, independent party is also conceivable. On a long-term basis, a close, comprehensive and property-overarching network can be developed in this way for standardised timber stack measurement within the forest.

The measurement system sScale™ 3.4

The stereo camera system sScale™ 3.4 is already widely used in Germany as a photo-optical wood stack measurement system. It has proven and established itself within everyday forestry under typical, not always simple framework conditions. With a measurement volume of approx. 3 million m³ of round lumber in the past year, relevant timber volumes are already being realised in Germany. The camera system is mounted on a vehicle and is operated by the driver via a screen inside the vehicle. When driving past the wood stack a photo sequence of the stack is recorded with two stereo cameras, which enables photo-optical measurement of the front area of the stack and automatic determination of the unit quantity with diameter distribution of the trunk end faces if necessary, and makes reference measurements superfluous due to the stereo camera concept. All stack data is immediately available and can be verified by the system user on location. Through the use of powerful LED headlamps - positioned between the cameras (Figure 1) - measurement is possible around the clock and in all weather conditions. In Germany, between 200,000 and 350,000 m³ of round lumber are measured as standard per measuring device and year by a single device user, and made available online for the logistics process in a timely manner.

Legal framework of the conformity evaluation of sScale™

Since the MessEG and MessEV regulations came into effect on the 01/01/2015, the forestry and timber sector has been subject to new legal framework conditions. In the conformity evaluation process, all measuring devices and processes must demonstrate that they are compliant with the new law, in order that they may be put into commercial circulation.

In the new MessEG law it is specified that a regulation committee of inquiry (REA) shall determine the rules, findings and technical specifications for the existing and in particular for new, innovative types of measuring devices on the basis of the latest engineering practice. The REA comprises the Physikalisch Technische Bundesanstalt (PTB) [German test authority], the authorities responsible within the federal states, conformity evaluation centres, state-approved test centres, industry and consumer associations, whose members are appointed by the federal ministry of economics (BMWi).

However, with the new MessEG and MessEV regulations, Dralle A/S also gained the opportunity to obtain a conformity evaluation within the framework of module G for sScale™ as an individual measuring device. Requirements and test conditions were published in a PTB information leaflet back in April 2015. On the basis of the new legal foundations, conformity evaluation processes were completed by Dralle A/S for 3 sScale™ systems in January 2016. These systems are in use in large-scale German forestry management right now.

Contents and scope of the individual device testing of sScale™ 3.4

In addition to the system description, the metrological testing of the precision and reproducibility of the photo-optical wood stack front area measurement, the safeguarding of software and hardware components against manipulation and electrical interference variables was also examined in detail, whilst defined specifications for the documentation and marking of the conformity evaluation were also implemented.

Metrological testing

The measurement resistance and precision could be verified for the bandwidth of measurement conditions relevant to forestry with a margin of error of +/- 3% of the area value. The measurement results for one and the same stack must therefore lie within the margin of error when measured with different sScale™ systems and by different device users. Two fundamental approaches were applied when evaluating the area measurement. On the one hand the precision in relation to a reference area (trapezoidal square), and on the other hand the reproducibility of the front area measurement on real wood stacks through repeat measurements.

Test design

In all, 5 device users and 3 sScale™ systems performed roughly 500 area measurements (actual stack front areas and defined reference areas). The conditions listed in Table 1 were tested. These test conditions (in particular the ambient conditions) are derived from the specifications of the OIML D11 directive. The OIML is an international organisation for the harmonisation of metrology in commercial relationships and formulates recommendations for the testing of measuring devices, which are not uncommonly applied in national laws.

Table 1: Test conditions, implemented in around 500 measurements with 3 measuring devices and 5 users, in order to verify the margins of error and measurement reproducibility.

Wood stack conditions	Ambient conditions	Driving movements
Number of reference areas: 7	Temperature: -20°C - +40°C	Distance from stack front 2m - 6m
Number of stack front areas: 5	Rel. humidity: 20% - 90%	Speed: 1 m/s - 10 m/s
Timber types: Spruce and maple	Light intensity 0 - 3000 Lux	Slalom: Amplitudes up to 4m
Surface area: 2.4m² - 52m²	Light: From the front, rear, side	Angled to and from the stack
Stack length: 2.7m - 25m	Cloud cover: Clear - cloudy	Ground unevenness: Height of 15 cm
Cut: Fresh - weathered	Twilight and night	Vibration and shock
Assortment: Industrial timber and sawn wood	Heavy rain (approx. 300l/m²*h) and drizzle; mist (with visibility down to 10m)	

Scope of validity

The scope of validity defines the permissible application framework in which assured measurements can take place, and is summarised in Table 2. On the system side, it is ensured that unfavourable measuring conditions result in error messages or the photo-optical image analysis is automatically interrupted.

Table 2: Scope of validity of the conformity-evaluated use of sScale™ 3.4

Nominal operating conditions	Validity conditions	
Measurement range	2 m² to 1000 m², limited by the maximum duration of capturing individual images	
Ambient conditions	Temperature range: Humidity conditions: Visibility: Mechanical ambient conditions: Electromagn. ambient conditions: It is fundamentally possible to measure under all weather and lighting conditions, as long as the image sequence captures the entire front area of the stack with the individual trunk ends in adequate quality.	-25 °C to +40 °C 20% to 90% rel. humidity with condensation Over 5m Class M3 Class E2
Vehicle movement	Vehicle distance: minimum 1.9m, maximum 6m Vehicle speed: up to 20 km/h	

Manipulation protection per WELMEC 7.2

In order to ensure protection of the software and hardware against intentional or inadvertent manipulation, it is necessary to implement various security precautions at software and hardware level. These security precautions have been tested for sScale™ in accordance with the software guidelines WELMEC 7.2 and evaluated according to the security classification of the device to be tested. In general, it is necessary to guarantee that manipulations are not possible, or only possible by leaving clear traces in the software. WELMEC is a European organisation that performs the task of harmonising statutory metrology in Europe and is also responsible for consistently high requirements applicable to the manufacturers of all types of measuring devices.

Figure 1: Photo-optical stereo camera system sScale™ 3.4, mounted on the roof rails of a carrier vehicle with two camera units and 3 LED headlamps, in front of an industrial timber stack requiring measurement.