



## EDITORIAL

The **Erythrocyte Sedimentation Rate (ESR)** is one of the most frequently prescribed laboratory tests and is useful as a non-specific screening assay for inflammatory processes as well as for monitoring therapy.<sup>[1]</sup> It is also known as the Biernacki Reaction due to its inventor Edmund Biernacki in 1897<sup>[2]</sup>. ESR is the rate at which red blood cells precipitate in a period of 1 hour. Anticoagulated blood is placed in an upright tube and the rate at which the red blood cells fall is measured in mm/h (mainly carried out as Westergren method). The basal ESR is slightly higher in females.

### NORMAL VALUES

Men under 50 years old:	< 15mm/h	Women under 50 years old:	< 20 mm/h
Men over 50 years old:	< 20 mm/h	Women over 50 years old:	< 30 mm/h

Any inflammation present will increase the ESR, but as it is a screening test, it cannot be used to diagnose a specific disorder. Examples for an increased ESR are: rheumatoid arthritis, thyroid diseases, tuberculosis, pregnancy. Lower than normal levels occur for instance with: sickle cell anaemia, congestive heart failure or low plasma protein due to liver or kidney disease.

The ESR is governed by the balance between pro-sedimentation factors, mainly fibrinogen, and those factors resisting sedimentation, i.e. the negative charge of the erythrocytes. If an inflammatory process is present, the high proportion of fibrinogen in the blood causes red blood cells to stick to each other. These agglomerates ("rouleaux") settle faster.

Greiner Bio-One has been selling ESR tubes since 1996. These first tubes were made of glass. The VACUETTE® 4NC ESR sodium citrate blood collection tubes are evacuated blood collection tubes used for the collection, transport and processing of venous blood for testing ESR in the clinical laboratory. The mixing ratio is 1 part citrate solution to 4 parts blood. The ESR plastic (polypropylene) tubes with a shelf life of 12 month are much safer than glass.

Greiner Bio-One also offers a range of analysers for the automated analysis of the ESR, for reliable and quicker measurement.

References:

[1] CLSI (Clinical and Laboratory Standards Institute). Reference and Selected Procedure for the Erythrocyte Sedimentation Rate (ESR) Test; Approved Standard – Fourth Edition. H2-A4, Vol. 20 No. 27.

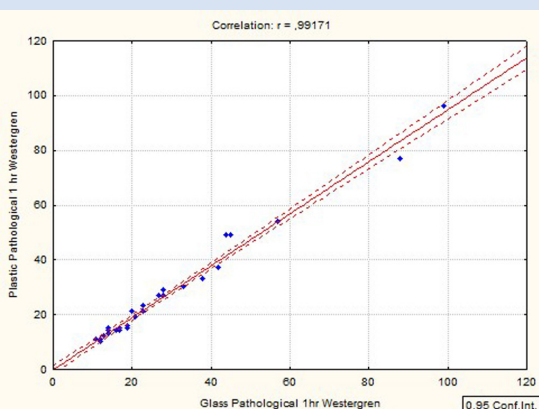
[2] J Rheumatol 2011;38:1521-1522

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## PRODUCT STUDIES

The International Council for Standardization in Haematology (ICSH) reviewed the recommendation for measurement of the erythrocyte sedimentation rate. According to the guideline the reference method for measurement of the ESR should be based on the Westergren method and blood samples may be drawn into sodium citrate directly, diluted to a proportion of 4 volumes of blood to 1 volume of citrate.<sup>[3]</sup>

Clinical Evaluations were carried out to assess the VACUETTE® ESR plastic tubes for their performance in comparison with the VACUETTE® ESR glass tubes. For the design of the study protocol, the recommendations from The International Council for Standardization in Haematology (ICSH) were considered regarding statistical methods, measurement range and sample size. In a first study the tubes were tested with the automated ESR measurement on the instrument SRS 20/II. The 1 hour Westergren values were determined by the 30 minutes automatic measurement, the 2 hours Westergren values determined by the 1 hour automatic measurement.



Values were obtained from both healthy donors and pathological donors and result comparisons between the VACUETTE® ESR glass tubes and the VACUETTE® ESR plastic tubes for 1 hour and 2 hour Westergren values were performed. No clinically relevant deviations between glass and plastic tubes could be observed.<sup>[2,4]</sup>

Graph: Regression line. Pathological donor results at 1 hour Westergren for glass and plastic tubes (mm) for the automated ESR measurement<sup>[4]</sup>

Another study investigated the performance of the VACUETTE® ESR plastic tubes in comparison with the VACUETTE® ESR glass tubes with the closed manual ESR measurement using a Greiner ESR rack with scaling. The closed manual ESR measurement delivers the 1 hour Westergren value after 60 minutes and the 2 hour Westergren value after 120 minutes. Whenever applicable, a nomogram for correlation to 18°C for Westergren's method was used for values measured over the recommended room temperature (between 18°C and 25°C). No significant differences could be detected, neither statistically nor clinically. [1,5]

On the basis of these studies, the VACUETTE® ESR plastic tubes can be used for the determination of Erythrocyte Sedimentation Rate.

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## References:

- [1] Manley, R. (1975). The effect of room temperature on erythrocyte sedimentation rate and its correlation. J. Clin. Path 10, 354, Department of Medicine, St. Stephen's Hospital, London.  
[2] Koch, P. (2001). Comparison of Manual vs. Automated Blood Sedimentation Test: Quality and Economy. J Lab Med. 25 (5/6), 189-194.  
[3] Jou, J. (2011) ICSH review of the measurement of the erythrocyte sedimentation rate. International Journal of Laboratory Hematology. 33, 125-132.  
[4] GBO White Paper. Evaluation of VACUETTE® Plastic ESR Tube with the automated ESR measurement on SRS 20/II.  
[5] GBO White Paper. Evaluation of VACUETTE® Plastic ESR Tube with the manual closed ESR measurement.

## TROUBLESHOOTER

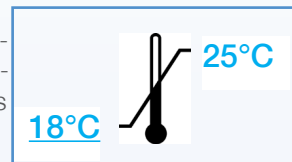
## Factors mostly affecting ESR

 Storage conditions prior to testing

Prolonged specimen retention (i.e., > 4 to 6 hours), especially if the specimen is not refrigerated, significantly degrades the validity of the test. Refrigerated specimens should be brought to ambient temperatures before testing.

 Temperature correlation (for manual ESR measurement)

A nomogram for correlation to 18°C (Manley Table, see SRS User Manual) has to be used for values measured at temperatures above the recommendation (between 18°C and 25°C). This applies to an exact documentation of the room temperature and correct transformation of the values to 18°C Westergren values


 Effect of direct sunlight

A possible temperature variation might occur if direct sunlight shines on some tubes, or if air vents from heating/cooling systems directly on the racks. Tubes inside the instrument are more protected from these influences.


 Position of working station

For the instrument as well as for the rack used for the manual closed ESR measurement a working station has to be chosen where there is no interference from other instruments causing vibration, like centrifuges or oscillating machines.

 Upright tubes

Any variations in the angle of the sedimentation tubes can be problematic. Tubes should be kept in an upright position.

 Correct mixing of blood specimen

Mixing the blood specimen is critically important for reproducibility. For all tubes there should be a minimum of 12 complete inversions with the air bubble travelling from end-to-end of the tube. First mix the tubes manually and then they can be put into a mixer prior to measurement.

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## References:

- [1] CLSI (Clinical and Laboratory Standards Institute). Reference and Selected Procedure for the Erythrocyte Sedimentation Rate (ESR) Test; Approved Standard – Fourth Edition. H2-A4, Vol. 20 No. 27.  
[2] Manley, R. (1957). The effect of room temperature on the erythrocyte sedimentation rate and its correlation. J. clin. Path, 10, 354.  
[3] SRS 20/II User manual – Revision 2. (2009). Greiner Bio-One.