# Background Information on Circumference Dendrometers

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In order to measure the changes of tree circumference, the sensor part of the dendrometers must be pressed against the stem surface. Thereby two important requirements have to be considered, to obtain meaningful dendrometer data: 1. Contact pressure at the stem surface must be as low as possible, so that small variations can still be recorded. 2. The pressure must be independent of stem diameter.

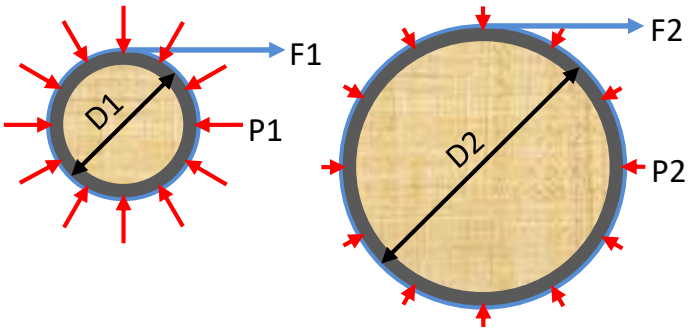
Among the available circumference dendrometers, two groups can be classified: Dendrometers mounted with tangential pulling force (TF-dendrometers) and dendrometers mounted with radial pressing force (RF-dendrometers). The contact pressure of dendrometers with tangential traction decreases with stem diameter. The larger the diameter, the smaller the contact pressure. Data of TF-dendrometers is hence dependent on diameter and not comparable between trees of different size.

## Mounted with tangential pulling force (TF)

**DC1**

**D6**

**DRL26,DBL60**




**Force illustration of TF Dendrometers**

| | | |
|---|---|---|
| Diameter | : | D1<D2 |
| Applied Pulling Force: | | F1=F2 |
| Pressure at tree | : | P1 >>> P2 |

The above figure illustrates diameter dependency of TF-dendrometers and shows how contact pressure decreases with increasing diameter. This relationship can be easily derived from the Laplace equation, which is also commonly used in medical research e.g. to calculate contact pressure of bandages (https://doi.org/10.1053/apmr.2002.33985)

The pressure difference causes two problems:

1. Systematic measurement error in the data, because they are measured under different contact pressures.
2. Unstable mounting of the TF-dendrometer, i.e. sliding down op the stem embracing band on stems with large diameters due to low contact pressure.

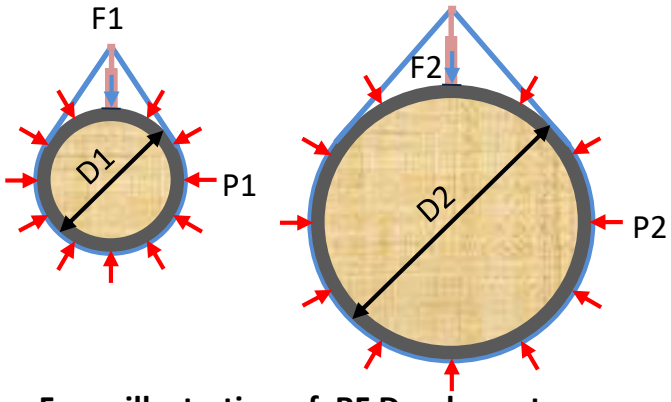
The Reason for this difference in pressure is due to the different curvature. A Small circle has a greater curvature than large circle. With the same tangential traction, a greater curvature leads to higher radial pressure. Example: Although a smaller balloon has a lower tangential traction than a large balloon, it needs much more pressure to be inflated than at a large balloon.


**Small balloon, high pressure (F1>F2)**

## Mounted with radial pressing force (RF)

**DC2**

**DC3**




**Force illustration of RF Dendrometers**

| | | |
|---|---|---|
| Diameter | : | D1<D2 |
| Applied Pressing Force: | | F1=F2 |
| Pressure at tree | : | P1 > P2 |

Contact pressure of RF dendrometers is tree-size compensated. This ensures an improved data comparison between trees of different stem diameter. The band will sit tight even on very large trees.