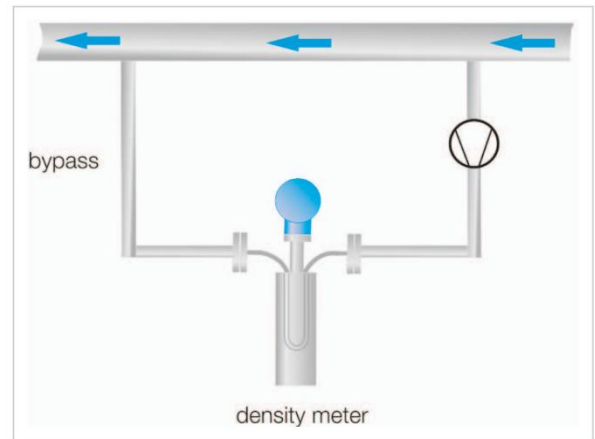
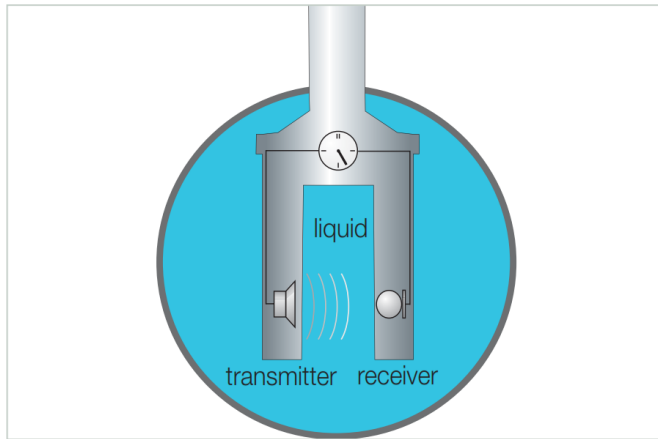


# Do you know the differences and the resemblances between sonic velocity and density measuring methods?



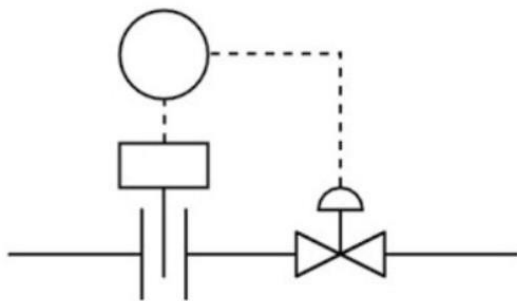
## Measuring principle of Sonic Velocity

## Measuring principle of Density

|                             | Sonic velocity   | Density   |   |
|-----------------------------|--|---|---|
|                             | Ultrasonic sensor  | Oscillating U-tube  | Mass flow sensors (Coriolis)                                  |
| concentration determination | specific sonic velocity is required; (laboratory testing or media databases) | sufficient documentation of specific density for many liquids | indirect density calculation by measurement of Coriolis force |
| calibration liquid          | water  | reference liquid (reference density)                          | reference liquid (reference density)                          |
| operating temperature       | -90 to 200 °C  | -50 to 200 °C   | -40 to 200 °C   |
| typical accuracy            | ±0.05 wt%  | ±0.05 wt%   | ±0.1 wt%  |
| installation                | no conditions  | bypass  | inline, fixed support structures                              |
| installation in vessel      | direct, no dead space  | only through external bypass                                  | only through external bypass                                  |
| maintenance                 | not required   | not required  | not required  |
| execution                   | inline, relatively easy, robust  | bypass NPS 6..25  | inline, large, difficult                                      |
| stopping pipe               | not required   | not required  | required  |
| gas bubbles, sediment       | marginal impact on measuring accuracy, alarm signal                          | results in false measurements                                 | results in false measurements                                 |
| deposits                    | impact only with large deposits  | small and large deposits influence oscillation properties     | small and large deposits influence oscillation properties     |
| vibrations                  | no impact (operating frequency > 1 MHz)                                      | sensitive (operating frequency several hundred Hz)            | sensitive (operating frequency several hundred Hz)            |
| pressure surge              | does not influence measuring accuracy  | can influence measuring accuracy                              | can influence measuring accuracy                              |
| special materials           | numerous available   | with high nominal diameter very expensive                     | with high nominal diameter very expensive                     |
| pressure loss               | minor  | minor, because of bypass                                      | high  |
| weight                      | 4 to 6 kg  | 2 to 4 kg   | 10 to 300 kg  |

## Density and sonic velocity of several liquids

| Liquid               | Sonic velocity [m/s] | Density [kg/dm <sup>3</sup> ] |
|----------------------|----------------------|-------------------------------|
| carbon tetrachloride | 938                  | 1.595                         |
| chloroform           | 1005                 | 1.489                         |
| tetra bromide methan | 1041                 | 2.963                         |
| acetic acid          | 1150                 | 1.049                         |
| ethyl alcohol        | 1180                 | 0.789                         |
| acetone              | 1192                 | 0.799                         |
| cyclo hexane         | 1284                 | 0.779                         |
| formic acid          | 1287                 | 1.212                         |
| petroleum            | 1295                 | 0.825                         |
| kerosene             | 1301                 | 0.805                         |
| benzene              | 1326                 | 0.878                         |
| sulfuric acid        | 1455                 | 1.814                         |
| water                | 1498                 | 0.998                         |
| hydrochloric acid    | 1510                 | 1.174                         |
| formaldehyde 60 %    | 1516                 | 1.103                         |
| anilline             | 1656                 | 1.022                         |
| glycerin             | 1923                 | 1.261                         |



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