peak echo amplitude at a predetermined frequency for each of the detected echoes and determining a value corresponding to the decay rate of the selected peak echo amplitudes as a function of echo number;

determining a second value corresponding to an acoustic property of the fluid from the first value and a predetermined calibration value;

determining a third value corresponding to speed of ultrasound in the fluid; and

determining a physical property of the fluid as a function of the second and third values.

21. The method of claim **20** wherein the transducer has a face associated with the second surface of the wall and the distance between the inner surface and the opposed surface is less than the largest dimension of the transducer face.

22. The method of claim **20** wherein the majority of the detected pulse echoes used to determine the first value have a pathlength in the member less than about 0.25 D^2/lambda, where D is the maximum length dimension of the transducer face associated with the member and lambda is the average wavelength of the ultrasound in the wall.

23. The method of claim **20** wherein the wall is metal.

24. The method of claim **20** wherein providing the transducer in association with the wall includes associating the transducer with the wall of an existing fluid conduit or container.

25. An system comprising:

a member comprising solid material having opposed first and second surfaces with the second surface adapted to contact a fluid,

a first ultrasonic transducer in association with the first surface of the member,

a pulser coupled to the transducer; and

a processing apparatus coupled to the transducer;

wherein the pulser is operable to cause the first transducer to deliver a pulse of ultrasound to the member for reflection between the first and second surfaces a predetermined number of times to produce an ultrasound pulse echo series at the transducer;

wherein the processing apparatus is operable to receive signals representing the response of the first transducer to the echoes of the echo series; and

wherein the processing apparatus is operable to determine:

a first value corresponding to an average decay rate of the pulse echoes of the echo series;

a second value corresponding to an acoustic property of the fluid from the first value and a predetermined calibration value;

a third value corresponding to speed of ultrasound in the fluid; and a physical property of the fluid as a function of the second and third values.

26. The system of claim **25** wherein the transducer has a face associated with the first surface and the distance between the first and second surfaces of the solid member is less than the largest dimension of the transducer face.

27. The system of claim **25** further comprising at least a second transducer for determining the speed of ultrasound in the fluid by performing a time-of-flight measurement.

28. The system of claim **27** wherein the second transducer operates at a lower frequency than the first transducer.

29. The system of claim **25** further comprising a fluid in contact with the second surface of the solid member.

30. The system of claim **25** wherein the pulser is operable to deliver a non-sinusoidal impulse to the transducer to cause the transducer to deliver a pulse of ultrasound to the member.

31. The system of claim **25** wherein the physical property is density and the processing apparatus is operable to determine a second property selected from the group consisting of viscosity, shear modulus, and shear speed from the determined fluid density and output signals from a second ultrasonic transducer.

32. The system of claim **31** wherein the first transducer is a longitudinal wave transducer and the second transducer is a shear wave transducer.

33. The system of claim **32** wherein the first and second transducers are each coupled to the member comprising solid material.

34. A method for determining a fluid property comprising:

delivering an ultrasound pulse to a member with a transducer, the member being comprised of a solid material and having a first surface in contact with a fluid and a second surface coupled to the transducer, wherein the surfaces are oriented to produce an ultrasound pulse echo series at the transducer;

detecting a plurality of the ultrasound pulse echoes of the echo series with the transducer;

fitting a curve to at least three data points to determine a first value, the first value corresponding to a decay rate of the plurality of the ultrasound pulse echoes;

determining a second value corresponding to an acoustic property of the fluid from the first value and an established calibration value;

determining a third value corresponding to speed of ultrasound in the fluid; and

determining a physical property of the fluid as function of the second and third values.

35. The method of claim **34** wherein the ultrasonic pulse is a shear wave and the physical property is selected from the group consisting of viscosity, shear modulus, and shear speed.

36. The method of claim **34** wherein an ultrasonic shear wave transducer and an ultrasonic longitudinal wave transducer are each provided and wherein fluid density and a property selected from the group consisting of viscosity, shear modulus, and shear speed are determined.

37. The method of claim **34** wherein the majority of the multiplicity of ultrasound pulse echoes used to determine the first value have a pathlength in the member less than about 0.25 D^2/lambda, where D is the maximum length dimension of the transducer face associated with the member and lambda is the average wavelength of the ultrasound pulse in the member.

38. The method of claim **34** wherein the first value is determined by selecting a peak echo amplitude at the same frequency for each of the detected echoes and determining a value corresponding to the average decay rate of the selected peak echo amplitudes for each of the ultrasound pulse echoes as a function of echo number.

39. A method for determining a fluid property comprising:

delivering an ultrasound pulse to a member with a transducer, the member being comprised of a solid material and including a first surface opposite a second surface, the first surface being coupled to the transducer and the second surface being in contact with a fluid, the ultrasound pulse reflecting between the first surface and the second surface to provide an ultrasound pulse echo series;

detecting a multiplicity of the ultrasound pulse echoes of the echo series with the transducer;

determining a first value froth the multiplicity of the ultrasound pulse echoes, the first value corresponding to a decay rate of the multiplicity of the ultrasound pulse echoes;