
White Paper

Guide to Pressure Transducer Selection



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Most applications for pressure transducers are relatively straightforward. Install the transducer according to manufacturer's recommendations, and obtain an accurate reading from an exceptionally reliable device. But life does not always follow the straight and narrow path. The purpose of this article is to provide some guidelines for helping a transducer user detect atypical conditions and compensate for them through the proper selection and application of the transducer.

Why Use a Transducer?

Pressure transducers are used to generate an electrical output for a variety of uses that may include computerized data collection, process monitoring and control, or electronic transmission of a pressure reading to a remote display. Another reason for using transducers is their accuracy. Transducers provide accuracies ranging from 0.1 percent full scale, with a typical accuracy of 0.5 percent.

The greater the accuracy required, the more expensive the pressure measuring device. But since product quality in many processes is directly related to how accurately the pressure is maintained, the expense of a more accurate device will quickly be justified.

Dealing with Abnormal Conditions

Once the need for a pressure transducer has been determined, it is prudent to determine if there might be some out of the ordinary conditions that could upset transducer performance. The balance of this article will identify some of these conditions and what can be done to compensate for them.

Temperature Dynamics

Two sources of temperature variation can affect transducer performance-ambient conditions and the fluid medium itself. Ambient conditions include such things as abrupt changes in air temperature due to heating and cooling systems cycling on and off and the effects of radiant energy impinging on the transducer. Variations in the fluid temperature occur most often during start-up of a process as the fluid goes from room temperature to a higher operating temperature.

Dynamic temperature problems may arise because pressure transducers are calibrated under static conditions of both pressure and temperature. Dynamic temperature effects in the field, therefore, may be superimposed on a steady pressure condition and cause an unstable reading. The easiest solution to this problem is to wait for the temperature to achieve a steady state before making a pressure reading.

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If accurate pressure readings must be made during large ambient temperature transitions, then corrective measures must be taken. Shielding the transducer may ameliorate ambient temperature shifts; you can build a baffle around it or wrap it with Styrofoam or some other insulating material.

One-way to compensate for temperature effects of the media is to buffer the transducer by placing it at the end of a short length of stainless steel or copper tubing. The tubing dissipates excess heat at a rate determined by the material, diameter, and length of the tubing. Charts are readily available to help determine the proper dimensions of the tubing. This tubing forms a constant and acceptable temperature link between the transducer and the main body of fluid media.

Media Compatibility

Most transducer media contact surfaces are made from stainless steel, either 17-4PH (precipitation hardenable) or 15-5PH. These are excellent special-purpose materials providing corrosion resistance similar to 303 and 304 grades of stainless steel. These materials handle most fluid media very well. If you know from previous experience, however, that these materials are unacceptable, then inform your transducer supplier. It is very likely that other options are available.

Mechanical Shock and Vibration

Excessive mechanical shock and vibration could develop due to reciprocating engines, piston pumps, hydraulic cylinders, and cycling valves. Cables that are subjected to continuous flapping may eventually break, and pressure fittings might eventually work loose.

Strain-gauge transducers typically hold up extremely well under shock and vibration, and field-testing by manufacturers has brought about continual improvement in this area. This does not mean, however, that all caution should be thrown to the wind. If a transducer is likely to be exposed to a great deal of shock and vibration, tie the cabling down and/or protect it with conduit. Also use a high-quality pressure fitting and make certain that the transducer has been properly tightened.

Dynamic Overload

A dynamic overload is a transient pressure spike of a magnitude greater than normal operating pressure. Such overloads may be present due to complex system dynamics and are very hard to trace. They can be as much as 10 times greater than the system pressure the transducer was designed to measure.

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Dynamic overloads can place unacceptable stress on the transducer diaphragm and could cause zero shifts and possible transducer damage. The nature of these adverse effects depends on the magnitude and duration of the over-load. Short duration overloads usually present fewer problems than long duration overloads, which can seriously diminish transducer performance.

If a zero shift due to an overload is suspected, drop the pressure in the system to zero and check the transducer's zero output. Usually, a high positive zero shift is an indication of a pressure overload. If pressure spikes are a persistent problem, you may need to buy a higher rated transducer or correct the system dynamics with surge tanks and/or snubbing devices such as quick opening bypass valves, spring-loaded ball valves, and sintered metal snubbers. Also, relocation of the transducer may diminish or eliminate the overload condition.

One Dynisco customer who needed to measure a pressure typically at 100-psi had severe system transients to 750-psi and was damaging 100-psi transducers. Because the ambient and fluid temperatures were quite steady, the customer was able to buy a 500-psi transducer and operate it at one-fifth the signal. Using the higher range unit eliminated all transducer damage.

Fortunately, most transducers do not have to worry about dynamic overload. If you don't think you have a dynamic overload problem, then you probably don't. If a problem does exist, your supplier will help you evaluate the options.

Dynamic Response

Most transducer users want to measure pressure in a steady state. They don't want to know what is happening to the pressure as changes take place. However some users want to measure dynamic pressure changes in the system. For these users, it is very important that they tell their transducer supplier that this is what they want to do.

The dynamic response of a system is a very complicated subject. This complexity is further compounded by the sometimes-misunderstood usage of such terms as frequency response, dynamic response, response to a step input, and rise time. These terms mean one thing when applied to the transducer and another when referring to the system. If dynamic measurements are required, it is wise to discuss the application with the manufacturer and seek his advice.

In addition to entering into a dialogue with your supplier, here are a few additional guidelines for using transducers to measure dynamic pressure:

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1. Couple the transducer as near as possible to the measuring point
2. Use a flush diaphragm transducer instead of a cavity type for better frequency response.
3. Avoid isolating the transducer with tubing or snubbers because system dynamics will change.

Handling and Installation

As mentioned earlier, today's pressure transducer is an exceptionally rugged device. Even so, it pays to exercise a little common sense during handling and installation. Here are a few easy-to follow tips:

1. Be careful with the electrical termination. Damage to the electrical connector or cable could put the transducer out of service.
2. Never poke the diaphragm of a low-capacity transducer with a pencil point or other stiff object.
3. This could damage the diaphragm, which in turn would affect transducer performance.
4. Do tighten the transducer well, making certain there is no leakage at the pressure connection.
5. Make sure the pressure fitting is made of a compatible material. Combining materials with different expansion characteristics (say a brass fitting and a steel transducer) could result in a leak.
6. If the transducer has a zero and span adjustment, position it so the adjustment can be reached with a screwdriver.
7. Upon installation of the transducer, check the entire system for proper wiring, integrity of connections, and proper grounding.

Conclusion

Remember, experience has shown that most problems are instrument-or-system related, not transducer related. Poor electrical connections and improper grounding could cause elusive intermittent problems. If the problem persists even after a thorough system check, it may be reasonable to suspect that the transducer is faulty.

This article has addressed questions users most often ask about the selection and application of pressure transducers. If you have any of the problems mentioned here, then it might be wise to consult directly with your transducer supplier. Tell him what your application is and what you hope to achieve through pressure measurement. A little time spent up front talking with the supplier can identify and compensate for potentially expensive problems before they have a chance to materialize.

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