P204: Selecting a Pressure Gauge

Where do we start?

There is no real standardisation on "quality". Quality today is measured by consistency, which standards such as ISO 9000 help to ensure. People do talk about **OEM** gauges, **Utility** gauges, **Industrial** gauges and **Process** gauges.

OEM Gauges are usually designed to a cost, intended for Original Equipment Manufacturers who incorporate these gauges in their products. As a result, quantities are often high. The Amekai type 213 is a good example.

Utility Gauges are seen as low cost gauges for end-users, often intended for utility applications, water, air etc. These are usually throw away designs. They are intended to indicate the rough state of utilities like compressed air. Accuracy is not a concern, they are used for trouble shooting. They are not used for quality critical applications, and hence are rarely certified, except where required by legislation. Their cost is such as to make replacement cheaper than repair, so they are considered disposable, usually but not always, made with sealed cases. The Amekai type 412 is a good example.

Industrial Gauges are heavier duty designs, intermediate between the utility gauges and the process gauges described below. They may still be disposable, but are often repairable, particularly where they have an impact on product quality, and need to be maintained in calibration. Blanes type 520 is a good example.

Process Gauges are designed for continuous process industries, where the plant runs 24/7, and a malfunctioning gauge can have financial consequences far beyond its value. Process gauges are usually stainless steel, and will be repairable and adjustable. Cost is less of an issue, and premium gauges can be justified for lower lifetime cost.

We have 2 main ranges available: the Amekai low cost gauges, including the Stronga stainless steel range, and the Blanes/Stewart range, developed by Stewart Buchanan in Scotland, and sold with our logo. These may be assembled locally. We ignore all the special gauges at this stage, as these requirements are usually clearly defined. The Amekai and Stronga are standard stock items or imported in large quantities, while the Blanes gauges may be stock, may be assembled, or may be imported in small quantities.

Apart from large volume OEM enquiries where the customer knows exactly what he wants, many enquiries come from buyers and resellers who are not end-users, and have been given insufficient information. It is your job to do what you can with what is available.

Step 1 is to listen to what information the customer does have.

Application:
It always helps to know what the intended service is. If the application is not familiar, ask what the problems are. If the customer tells you the application is slurry, you know that this must use a chemical seal. Simple clean non-corrosive fluids like air, fresh water and oil can be used with

brass/bronze wetted parts, others may require stainless steel or more.

Quality/Cost:
If customer is looking for a low cost gauge, OEM or utility, look at Amekai/Stronga.

Model Numbers:
The main reason for having a comprehensive model number is to touch all bases, fill in all gaps, in short, to deliver what the customer really wants. If we determine a model number, we may be wrong on minor points, but the gauge as delivered should be usable.

Material:
If customer is looking at stainless steel in small quantities, then check configuration. Stronga is stocked as direct mounted 100mm ½" NPT bottom connection. Any other configuration is likely to be Blanes.

Configuration:
Most requirements are for direct mounting, where the gauge is simply screwed into the tapping point. This may also be called local mounting. The norm is bottom entry, radial 6 o'clock, our type 2. We can modify our Blanes gauges for other directions, e.g. 3 o'clock, by drilling extra holes in the dial. Back entry (axial) is also available. The smaller gauges from Amekai may be centre back. Blanes/Stewart, and larger Amekai gauges, will be lower back mount. This is our type 5.
Gauges may also be remote mounting, where the gauge is connected to the tapping point by a length of tubing. Gauges intended for fastening to a convenient flat surface, are referred to as surface or wall mounting. They have a back flange and are almost always bottom mounting. This is our type 1. The alternative remote mounting configuration is flush panel mounting. Tis means that only the face of the gauge is visible, and the bulk of the gauge is behind the face of the panel. The norm is then rear entry, which is most accessible for piping. We have two versions. Type 3 is a screw fixing design, where the gauge is fastened from the front, using 3 screws passed through 3 holes in a front flange. This requires 3 mounting holes to be drilled in the panel. Type 4 uses a clamp fixing, where the gauge is held in place by the pressure exerted by a U-clamp which pulls the gauge into the panel. No holes need be drilled in the panel, other than the main body cut-out.

Size:
<100mm is probably brass internals, probably disposable, probably Amekai. If it is not a stock configuration, 63mm, and only a small quantity is involved, then offer Blanes.
≥ 100mm is probably Stronga or Blanes.

Construction:
This refers to the Blanes range, where the Vibragauge option is popular.

Pointer Type:
Pointers are usually fixed, ie they are held fixed relative to the spindle by being driven onto a taper. Process gauges sometimes require an adjustable pointer, where a gear drive connected the pointer to the collet, which is the part fixed to the spindle. This allows the pointer to be rotated without removing it from the spindle.

Case Material:
OEM gauges are often plastic. Industrial gauges are often steel cased. Process gauges are usually 304 stainless steel. 316 stainless steel is difficult to form, and thus much more expensive. If case corrosion is a problem, one of the industrial plastics like polycarbonate is usually a better option.

Case Filling:
Filling the case with a thick liquid will damp oscillations of the pointer, and lubricate the gears in the movement, thus extending the life of the gauge. Liquid filling requires a sealed case, thus making construction more complicated. Glycerine is the main liquid used, being relatively cheap and viscous. It does decompose above 60ºC. Silicone oil is the usual alternative, but

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several times the price of glycerine. Silicone must be used if electric contacts are fitted.

Thread Type & Size:

This is one of the more difficult things to get right. The usual thread types for instruments are BSP and NPT. BSP is available in two forms, parallel (ISO type G, designed for sealing on a flat washer, often copper), and taper (ISO type R' designed to be sealed with thread tape or thread sealant). What complicates the issue is that the European Norm EN837 recognises BSP parallel and NPT, while most industrial pipe fittings in this country are BSP taper. BSPT and NPT are not interchangeable, except in ½". 40 – 63mm gauges are usually limited to ¼" and smaller connections. Larger gauges are usually limited to ½" connections.

The above points cover all standard requirements; as long as you can elicit answers, any gauge you supply should be OK. It is your responsibility to ensure these points are covered. Any additional special requirements are the customer's responsibility. He must tell you what his special needs are, if any.

Detailed Quotations:

Wherever practical, confirm verbal offers in writing. If customer cannot give you all the answers you need to complete a part number, you can suggest default values, but we must make clear what we are offering. We may learn that the customer asks for a gauge with a ¼" bottom connection. This in itself is enough to determine a price, but not necessarily availability, particularly with Amekai/Stronga. For example, we stock the Stronga AK612 with a ½" NPT connection. We could offer a G½ connection at the same price, if the customer wanted sufficient and was prepared to wait 6 weeks.

Where standard products are not suitable:

Our main concern is gas measurement. Our concern is safety, based on the compressibility of fluids. Liquids are nominally incompressible. If we release the pressure on a liquid, say because a tube fails, and considering the case where the volume is fixed, say because an isolating valve is closed, the volume will expand a minute amount, and the pressure is then dissipated. In the case of gases, different conditions apply. Gases are compressible, and with a perfect gas at constant temperature, the product of pressure and volume remains constant, algebraically, $PV = K$. This means that a compressed gas at 10 MPa absolute, will expand 100 times in volume if the pressure is released. In a pressure gauge, when a tube fails, the case, with its window, becomes a secondary containment vessel. The weak point is the window, which will fracture, and the ever expanding gas will blow the glass fragments outwards. In real life, when the gauge is on-line, the contents of the tube will be replaced as fast as fluid can flow through the entry, compounding the problem.

To avoid such complications, gauges for gas pressure are specially built, with a solid front and a blow-out back, which is meant to dissipate the blast rearwards. In addition, a shatterproof type of window is used, either laminated safety glass, or polycarbonate. A restrictor is usually fitted to limit the flow of gas into the gauge.

Opinions vary over which pressures justify the added expense of such a design. The old SABS 1062 stated 6 MPa. European legislation mandates 2 500 kPa.

Oxygen ,acetylene and other oxidant gas gauges require safety construction at all pressures. This is because these gases are not inert, and may react explosively with some compounds, oxygen with oil, and acetylene with certain copper compounds. Such gauges may require special construction and marking, for example oxygen gauges must be completely oil free, and marked accordingly.

Special Designs:

These include low pressure (capsule) gauges for pressures below 60 kPa, test gauges of higher accuracy, and many others.

Differential Pressure Gauges:
These introduce a further parameter, static line pressure. DP Gauges are designed to measure the difference between two pressure sources. In some cases, we can do the job by using two normal pressure gauges, and subtract the readings. This is automatically less accurate, because each gauge has its own error. If we use two 100 kPa gauges measuring the same pressure, each gauge is allowed to be 1 kPa out, so in the worst case, the two gauges could differ by 2 kPa. If we are looking for a pressure difference of about 2 kPa, we are going to have problems.

The ratio of the pressure difference to the line or static pressure is important. Low ratios allow the use of twin bourdon tube designs, high ratios require more expensive diaphragm designs.

A low cost low performance requirement with high line pressures suggests the Orange Research range. The dial is 90ºC.

Greater sensitivity and less hysteresis is available from the Stewart and Budenberg ranges. Twin bourdon tube designs are cheapest, but have relatively low ratios of static to range, typically 3 to 10:1 Diaphragm designs offer higher ratios, look at Stewart and Budenberg for examples.

Accessories:
Other than chemical seals, which will be dictated by the application, accessories will be dictated by the customer. These include valves, siphons, contacts maximum pointers, red lines, colour bands, and more.

As you become more experienced, you will find that your brain will automatically discard certain options on hearing the customer's requirements, directing you to a short list, and encouraging you to ask questions to gradually eliminate all but one product offering.