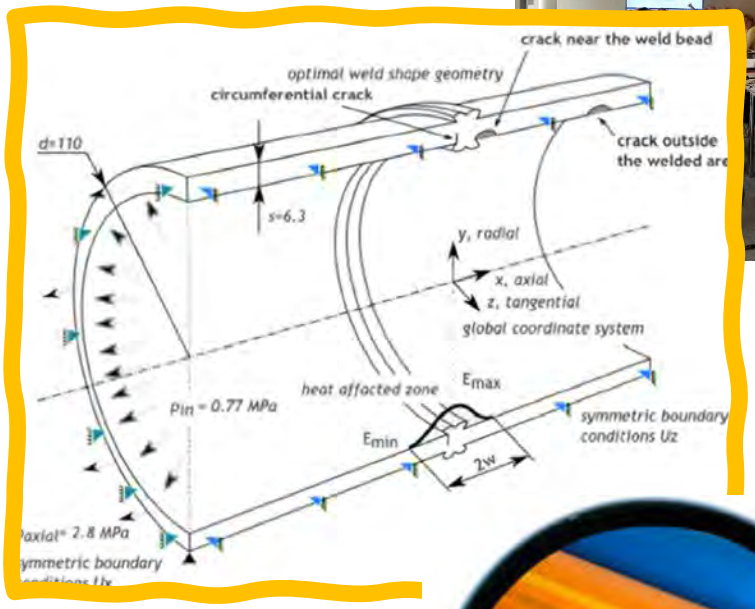
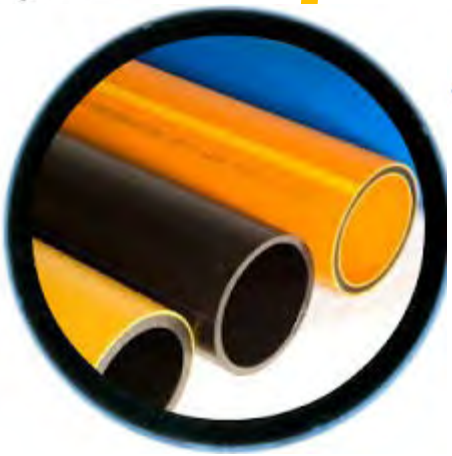
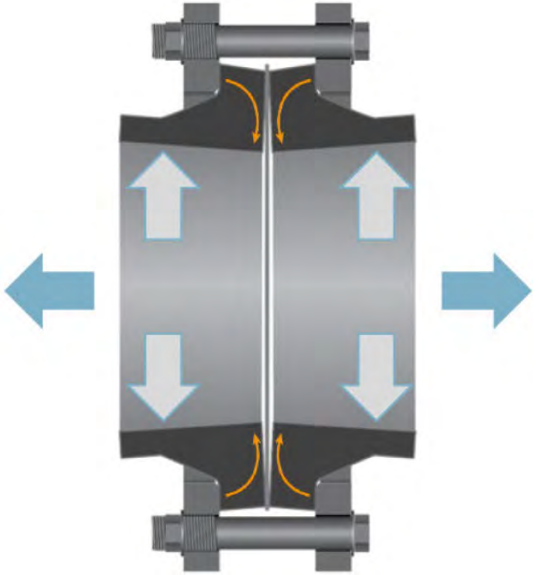
# SAPPMA Quality Workshop III





Co-presented by: IFPA

Ian Venter

19-02-2020

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# Pressure Fittings; Conformance


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19-02-2020

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# Why Quality Infrastructure

- The establishment of a Quality infrastructure is a key step in the development of any country.
- Quality infrastructure is the system of technical capabilities used to raise the quality of goods imported traded and exported.
- Quality infrastructure is used to protect markets, businesses and consumers and enables countries to integrate into the global trade system.

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# How do we turn it into sustainable quality management?

What exactly is sustainable quality management?

Traditional definition
A system, enterprise or function that can be sustained or maintained over a relatively long period of time.


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# Overview of Quality Assurance Measures in the Construction of Thermoplastic Pipelines

| Type of Measure | Standards, Directives and Regulations | Preferred Application | Remarks about the Frequency |
|---|---|---|---|
| **Material Tests** | | Manufacture of Compounds, Components and pipe Parts | Permanent with certification according to DIN EN 10204 (Types of Inspection Documents) |
| **Incoming Tests**<br>- **Semi-Finished products welding and filler materials** | | Fabrication | Permanent with the obligation to keep records |
| **Intermediate Tests**<br>- **Components**<br>- **Special Fittings** | | Fabrication | Object-Related with obligation to keep records |
| **Final Tests**<br>**Outgoing Inspections**<br>**-Pipeline Parts**<br>**-Assembly Devices** | | Fabrication, Assembly | Object-Related with obligation to keep records |
| **Checking of Machines and Devices** | | Fabrication, Assembly | At least once per year with documentation |
| **Monitoring of the fabrication and laying work** | | Fabrication, Assembly | Permanent with the obligation to keep Records |
| **Internal Pressure Test/Deformation checks** | | Assembly | Object-Related with Documentation |
| **Training of the supervisory personnel** | | Fabrication, Assembly | Annual updating by attending seminars etc. |
| **Training of the Welding, Jointing, Adhesive bonding personnel** | | Fabrication, Assembly | Annual Requalification Tests |
| **Advanced training of the Laying personnel** | Courses, Seminars | Assembly | Every 12 to 6 Months |

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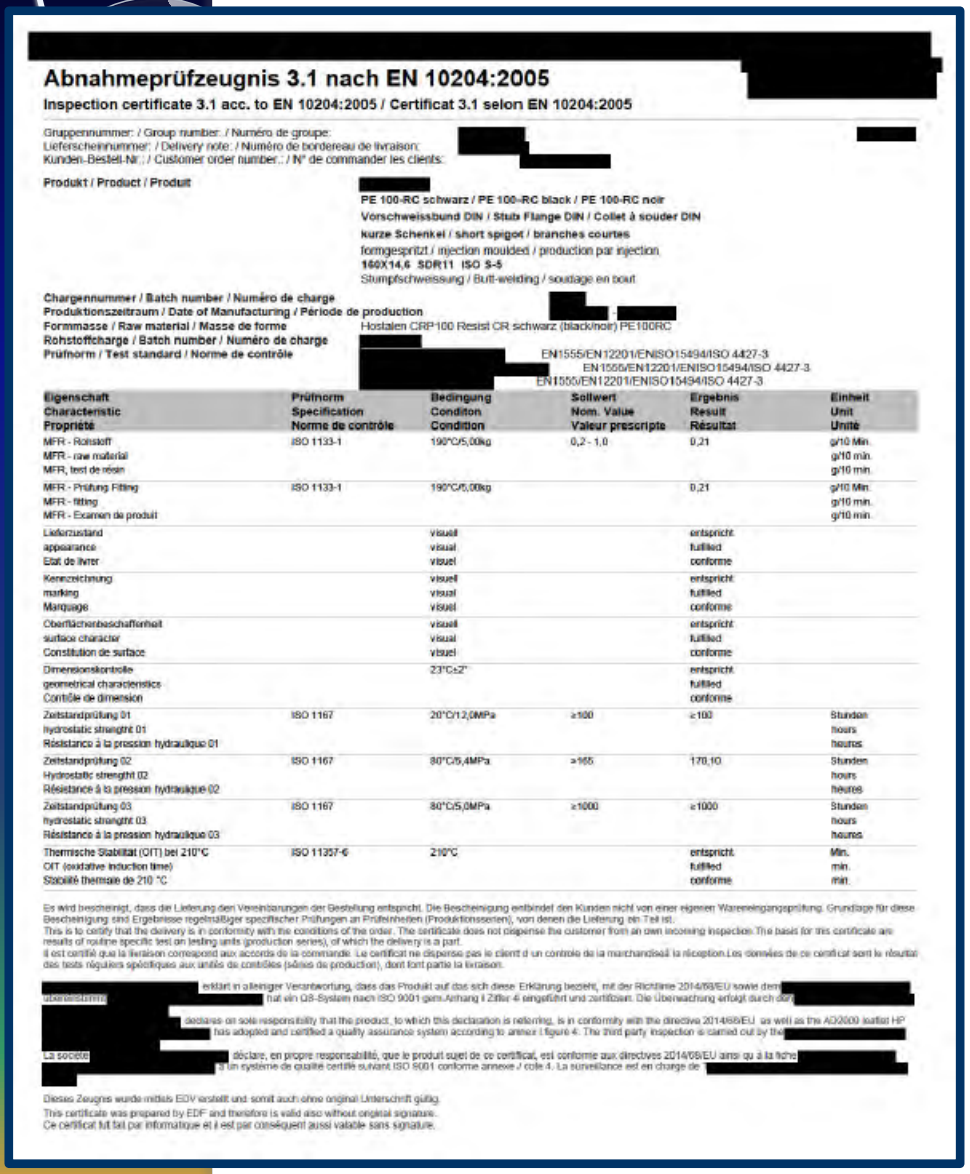
# Certificate of Conformance



**Abnahmeprüfzeugnis 3.1 nach EN 10204:2005**

**Inspection certificate 3.1 acc. to EN 10204:2005 / Certificat 3.1 selon EN 10204:2005**

Gruppennummer: / Group number: / Numéro de groupe:
Lieferscheinnummer: / Delivery note: / Numéro de bordereau de livraison:
Kunden-Bestell-Nr.: / Customer order number.: / N° de commander les clients:

**Produkt / Product / Produit**

**PE 100-RC schwarz / PE 100-RC black / PE 100-RC noir**
**Vorschweissbund DIN / Stub Flange DIN / Collet à souder DIN**
**kurze Schenkel / short spigot / branches courtes**
formgespritzt / injection moulded / production par injection
**160X14,6 SDR11 ISO S-5**
Stumpfschweissung / Butt-welding / soudage en bout

**Chargennummer / Batch number / Numéro de charge**
**Produktionszeitraum / Date of Manufacturing / Période de production**
**Formmasse / Raw material / Masse de forme** Hostalen CRP100 Resist CR schwarz (black/noir) PE100RC
**Rohstoffcharge / Batch number / Numéro de charge**
**Prüfnorm / Test standard / Norme de contrôle** EN1555/EN12201/ENISO15494/ISO 4427-3
EN1555/EN12201/ENISO15494/ISO 4427-3
EN1555/EN12201/ENISO15494/ISO 4427-3

| Eigenschaft<br>Characteristic<br>Propriété | Prüfnorm<br>Specification<br>Norme de contrôle | Bedingung<br>Conditon<br>Condition | Sollwert<br>Nom. Value<br>Valeur prescripte | Ergebnis<br>Result<br>Résultat | Einheit<br>Unit<br>Unité |
|---|---|---|---|---|---|
| MFR - Rohstoff<br>MFR - raw material<br>MFR, test de résin | ISO 1133-1 | 190°C/5,00kg | 0,2 - 1,0 | 0,21 | g/10 Min.<br>g/10 min.<br>g/10 min. |
| MFR - Prüfung Fitting<br>MFR - fitting<br>MFR - Examen de produit | ISO 1133-1 | 190°C/5,00kg | | 0,21 | g/10 Min.<br>g/10 min.<br>g/10 min. |
| Lieferzustand<br>appearance<br>Etat de livrer | | visuell<br>visual<br>visuel | | entspricht<br>fulfilled<br>conforme | |
| Kennzeichnung<br>marking<br>Marquage | | visuell<br>visual<br>visuel | | entspricht<br>fulfilled<br>conforme | |
| Oberflächenbeschaffenheit<br>surface character<br>Constitution de surface | | visuell<br>visual<br>visuel | | entspricht<br>fulfilled<br>conforme | |
| Dimensionskontrolle<br>geometrical characteristics<br>Contrôle de dimension | | 23°C±2° | | entspricht<br>fulfilled<br>conforme | |
| Zeitstandprüfung 01<br>hydrostatic strenght 01<br>Résistance à la pression hydraulique 01 | ISO 1167 | 20°C/12,0MPa | ≥100 | ≥100 | Stunden<br>hours<br>heures |
| Zeitstandprüfung 02<br>Hydrostatic strenght 02<br>Résistance à la pression hydraulique 02 | ISO 1167 | 80°C/5,4MPa | ≥165 | 170,10 | Stunden<br>hours<br>heures |
| Zeitstandprüfung 03<br>hydrostatic strenght 03<br>Résistance à la pression hydraulique 03 | ISO 1167 | 80°C/5,0MPa | ≥1000 | ≥1000 | Stunden<br>hours<br>heures |
| Thermische Stabilität (OIT) bei 210°C<br>OIT (oxidative induction time)<br>Stabilité thermale de 210 °C | ISO 11357-6 | 210°C | | entspricht<br>fulfilled<br>conforme | Min.<br>min.<br>min. |

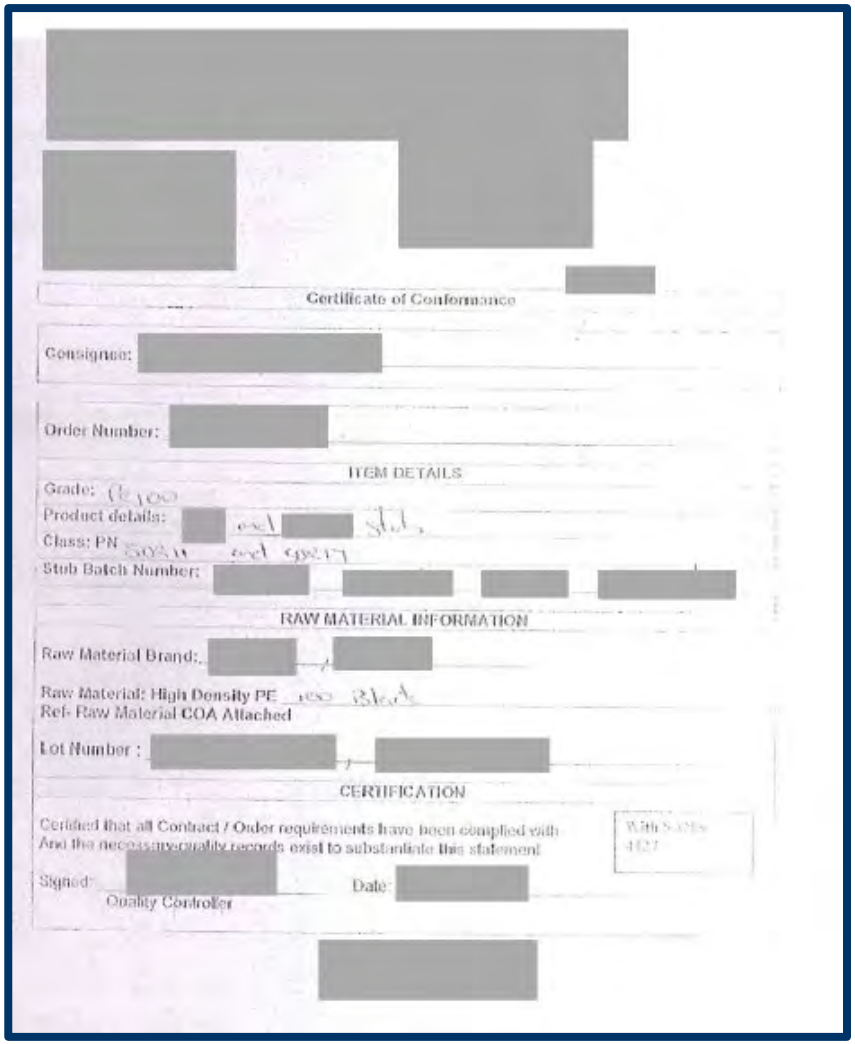
Es wird bescheinigt, dass der Lieferung den Vereinbarungen der Bestellung entspricht. Die Bescheinigung entbindet den Kunden nicht von einer eigenen Wareneingangsprüfung. Grundlage für diese Bescheinigung sind Ergebnisse regelmäßiger spezifischer Prüfungen an Prüfeinheiten (Produktionsserien), von denen die Lieferung ein Teil ist.
This is to certify that the delivery is in conformity with the conditions of the order. The certificate does not dispense the customer from an own incoming inspection. The basis for this certificate are results of routine specific test on testing units (production series), of which the delivery is a part.
Il est certifié que la livraison correspond aux accords de la commande. Le certificat ne dispense pas le client d un contrôle de la marchandise à la réception.Les données de ce certificat sont le résultat des tests réguliers spécifiques aux unités de contrôles (séries de production), dont font partie la livraison.

[redacted] erklärt in alleiniger Verantwortung, dass das Produkt auf das sich diese Erklärung bezieht, mit der Richtlinie 2014/68/EU sowie dem [redacted] übereinstimmt. [redacted] hat ein QS-System nach ISO 9001 gem.Anhang I Ziffer 4 eingeführt und zertifiziert. Die Überwachung erfolgt durch die [redacted]

[redacted] declares on sole responsibility that the product, to which this declaration is referring, is in conformity with the directive 2014/68/EU as well as the AD2000 leaflet HP [redacted] has adopted and certified a quality assurance system according to annex I figure 4. The third party inspection is carried out by the [redacted]

La société [redacted] déclare, en propre responsabilité, que le produit sujet de ce certificat, est conforme aux directives 2014/68/EU ainsi qu à la fiche [redacted] a un système de qualité certifié suivant ISO 9001 conforme annexe I / cole 4. La surveillance est en charge de [redacted]

Dieses Zeugnis wurde mittels EDV erstellt und somit auch ohne original Unterschrift gültig.
This certificate was prepared by EDP and therefore is valid also without original signature.
Ce certificat fut fait par informatique et il est par conséquent aussi valable sans signature.



[redacted]

Certificate of Conformance

Consignee: [redacted]

Order Number: [redacted]

ITEM DETAILS

Grade: [redacted]
Product details: [redacted]
Class: PN [redacted]
Stub Batch Number: [redacted]

RAW MATERIAL INFORMATION

Raw Material Brand: [redacted]

Raw Material: High Density PE [redacted]
Ref- Raw Material COA Attached

Lot Number : [redacted]

CERTIFICATION

Certified that all Contract / Order requirements have been complied with
And the necessary quality records exist to substantiate this statement

Signed: [redacted] Date: [redacted]
Quality Controller

[redacted]

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# Technical File ?

## Creating a technical file


The provisions regarding the CE mark compliance's documentation are a part of the New Approach directives. Accordingly, the manufacturer of record has the responsibility to develop a technical file, also called a technical construction file. The technical file documents all steps a product has taken to comply with the CE requirements. The manufacturer of record usually is the person who places a product on the market. He is further in charge of identifying the specific CE directives, requirements and conformity assessment procedures.

## The content of a technical file

The technical file shall consist of all documents spelt out in the list of essential requirements of the specific CE directives. In general, the technical file includes:

- A general description of your product;
- Information about your product's design (e.g. circuit diagrams, design drawings, mechanical drawings, component list, manufacturing documentation, etc.);
- Description and explanations necessary to understand the above-mentioned drawings;
- Installation description and user manual for the product. The installation description must clarify how users should install and use your product;
- A list of the applicable CE directives and essential requirements;

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# Technical File ??

- An analysis of the steps taken to ensure the safety of your product, including a list of the standards used either wholly or partially, or own standards/methods used to verify compliance with the respective CE directive; the results of any product resting; and, a product safety analysis. The safety analysis is mandatory for compliance of a product with the Machinery Directive, for example. By performing a safety analysis, the manufacturer of record assesses the risks' probability and severity posed by the product in some areas and consequently documents the measures taken for reducing the specific risks. The most residual risks must be limited by the usage of interlocks, while the minor residual risks can be acknowledged with warnings.
- Certificates of CE compliance of the product from any required notified body.
- Other grounds used or that may be of use (such as calculations, simulations, etc.);
- Test reports.

## Versions of a technical file

The preparation of the technical file is in two versions, conventionally named Part A and Part B. Part A contains all documents regarding the general design, manufacturing and testing of the product. Part A of the technical file is usually given to the surveillance authorities. Their interest is in verifying the CE mark's use for production series. Part B consists of the documentation concerning the full design calculations, complete reports, and individually CE marked pieces of equipment. The latter version is essential in cases of verifying the CE mark on a specific piece of equipment.

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# Technical File ???

## Authorized representatives

When creating a technical file, you should consider the official language of the country where you want to sell it. According to the CE directives and the European national laws, you should always have the user information translated into the respective official national language. The translation of the rest of the technical file could be in any other European language. Moreover, the technical documentation's location can be even outside Europe if the product's manufacturing is not within the European borders. That is possible as long as the manufacturer on record has appointed an "authorised representative" who can ensure its provision if requested by the European authorities. If the surveillance authorities have requested the technical file, the same generally should be provided within one working week. The authorised representative is mandatory for products falling under the scope of the Medical Device Directive, and optional for all other directives.

The manufacturer of record only needs to have one authorised representative in the EU zone. He will be contacted if an issue of CE mark conformity arises. The specific location of the authorised representative is not of importance as long as it's within the EU. For instance, if the authorised representative lives in Stockholm and someone in Berlin questions the CE compliance of a product, then the query will be forwarded to the Swedish authorities, who will contact the representative party. However, in case the particular product injures someone or seems to pose a safety threat, the German authorities have the right to take unilateral actions.

If the manufacturer doesn't have any authorised representative on the European territory, then the surveillance authorities can request the product's technical file from the importer, distributor or customers. If the person approached cannot ensure the provision of the documentation, the product in question can be pulled off the market and out of service.

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# Technical File ????

## To summarise

The technical file should prove your product's compliance with the CE directive/s. As a manufacturer, you should store it within the EU for about 10 years. If requested by authorities, you should be able to provide the technical documentation and a copy of your product's CE Declaration of Conformity within a short time frame.

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# Your Role in Conformance


**Procurement Process**

Product Planning

Production Planning

Identify Need

Make or Buy

Research

Select Prepare a Specification

Requisition Purchase

Specification Process

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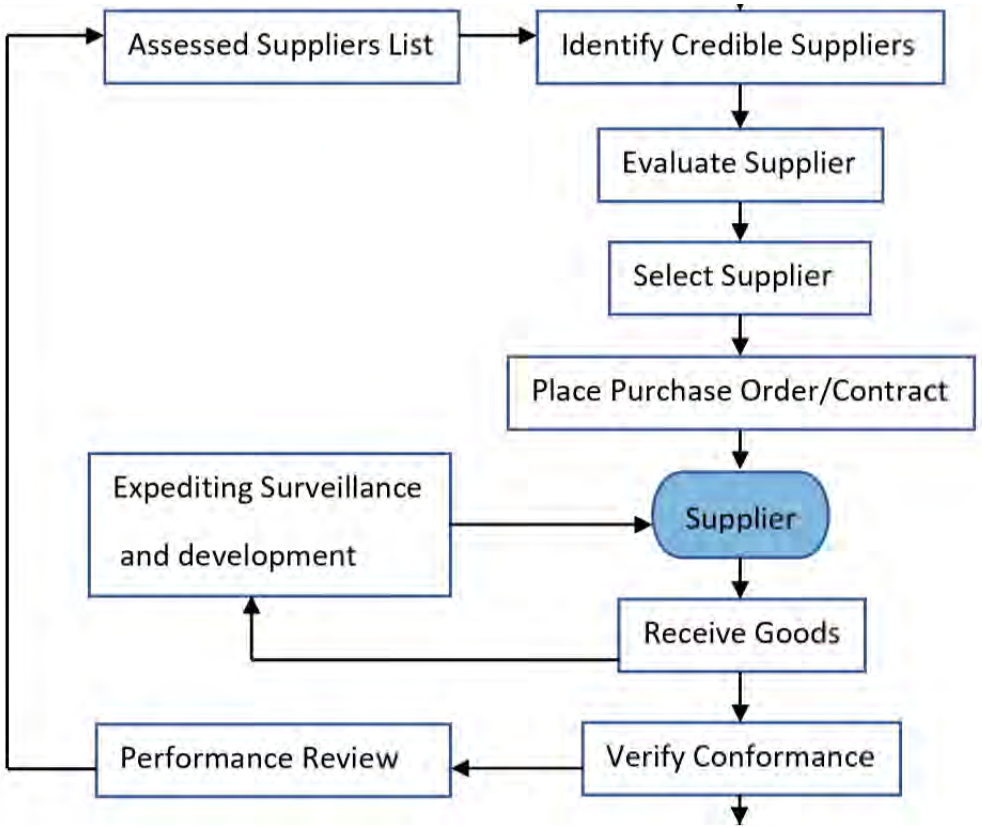
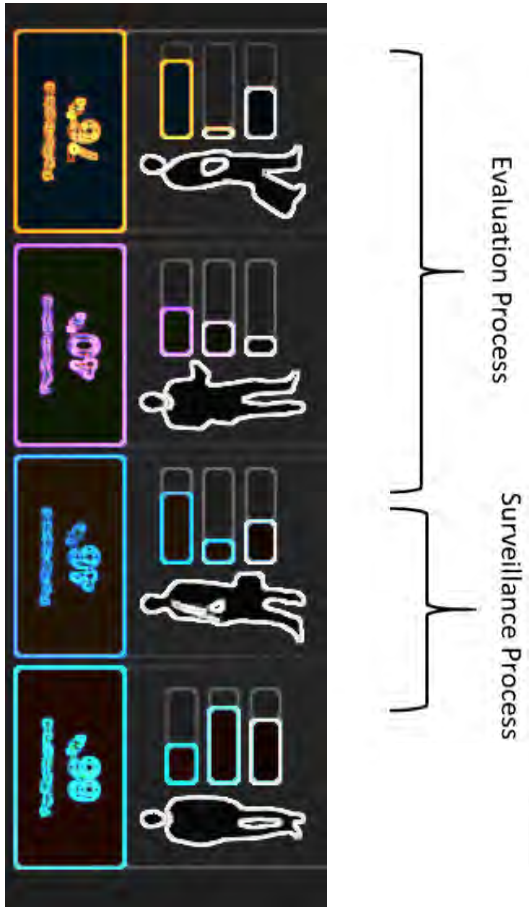
# Your Role does not stop after Specification

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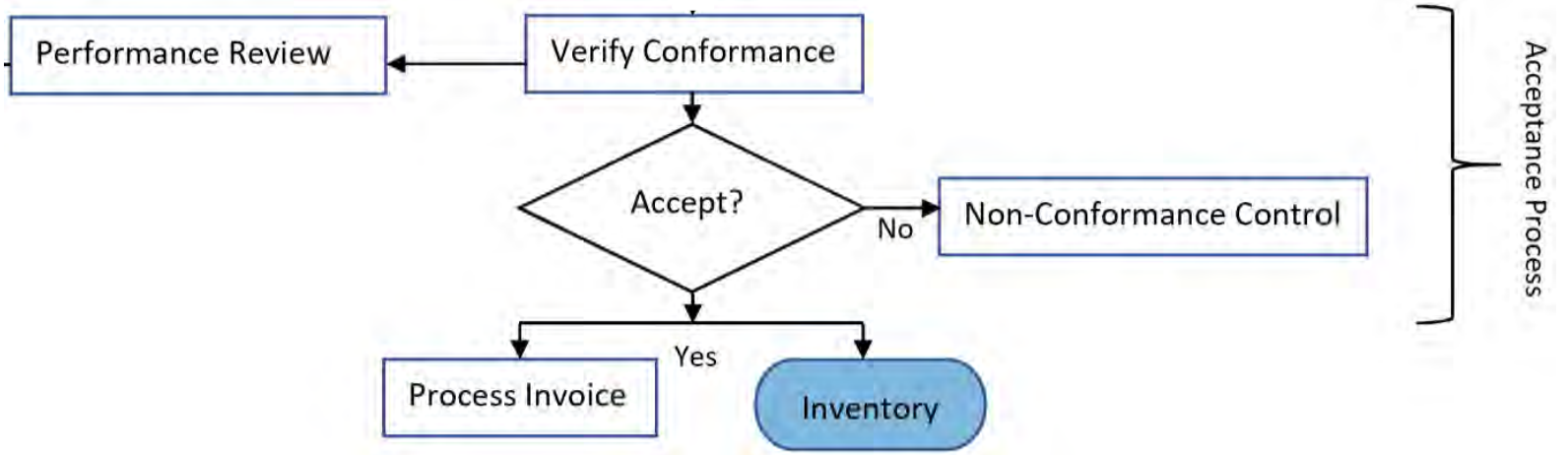
# Acceptance Process must be driven by the Specification





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# System Standards

ISBN 978-0-626-20747-2

**SANS 4427-1:2008**
Edition 1

**ISO 4427-1:2007**
Edition 1

ISO 4427 consists of the following parts, under the general title *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply*:

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

— *Part 5: Fitness for purpose of the system*


**Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply**

**Part 1: General**

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# Normative Standards

ISO/DIS 9624

ISO 4427-3:2007(E)

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

**Thermoplastics piping systems for fluids under pressure — Flange adapters and loose backing flanges — Mating dimensions**

*Titre manque*

ISO 9624, *Thermoplastics pipes for fluids under pressure — Mating dimensions of flange adapters and loose backing flanges*

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# Standards for Fabricated Fittings

- Not all fabricated fittings can be linked to a Local standard or normative standard

- Fabricated PVC fittings you may want to link into ISO standards such as ISO 21138-1, 2, 3 and or ISO 1452-3

**CE Marking is NOT Easy!**

**If you're thinking:**

- I don't know where to start
- I don't know what Directives apply to my product
- Should I use an on-line or paper-based system?


**Then you understand the problem and issues**

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# If the standards are not available

- Draw up own documentation based on guidelines of a System design code EN805, EN 806, other.
- Step 1: Determine the Applicable Directives and Standards;
- Step 2: Conformity Assessment (risk assessment, product testing, inspection etc.)
- Step 3. User Instruction and Product Label;
- Step 4: Building the Technical File;
- Step 5: Declaration of Conformity marking;
- Step 6: Ensuring Continued Compliance.

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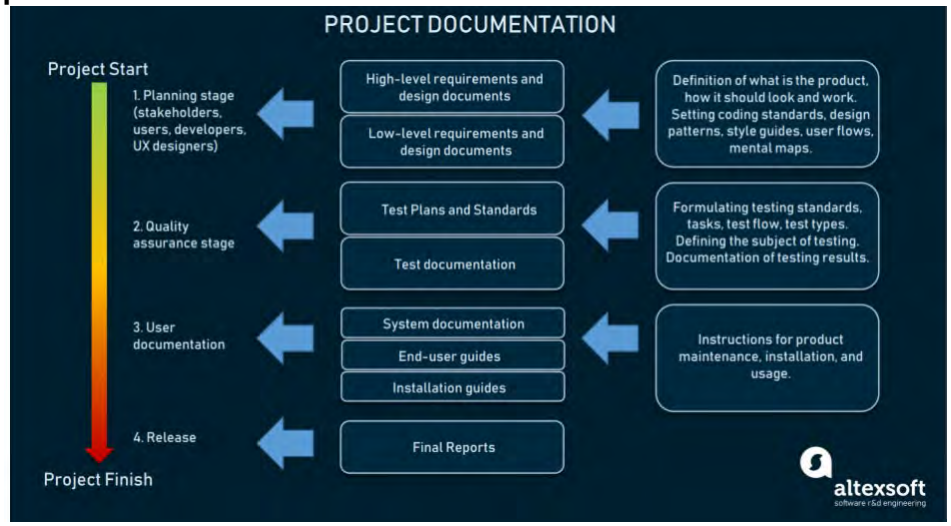
# Information that shall be contained in the Technical file

- Standards for all the components.
- Secondary pipe
- Pipe socket
- Seal ring
- Clip ring
- Solvent cement
- Champhoring
- Depth of insertion marks
- Marking
- Position of marking
- Sample of marking
- Component Quality Plan to be drawn up from this and agreed upon and signed off
- Process check sheet for fabrications processes
- Compile check sheets
- Sampling plans

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# Design Standards

**DVS Technical Codes on Plastics Joining Technologies**

| | |
|---|---|
| DVS 2205-4 Supplement | Calculation of thermoplastic tanks and apparatus – Welded flanges, welded collars – Constructive details ... |
| DVS 2205-5 | Calculation of thermoplastic tanks and apparatus – Rectangular Tanks ..... |

$$\sigma_u = \frac{p}{10} \cdot \frac{(d_a/d_i)^2 + 1}{(d_a/d_i)^2 - 1} \triangleq \sigma_y$$

DVS – DEUTSCHER VERBAND FÜR SCHWEISSEN UND VERWANDTE VERFAHREN E.V.

**Industrial Pipelines Made of Thermoplastics Planning and Execution Above-Ground Pipe Systems**

DVS Technical Code DVS 2210-1

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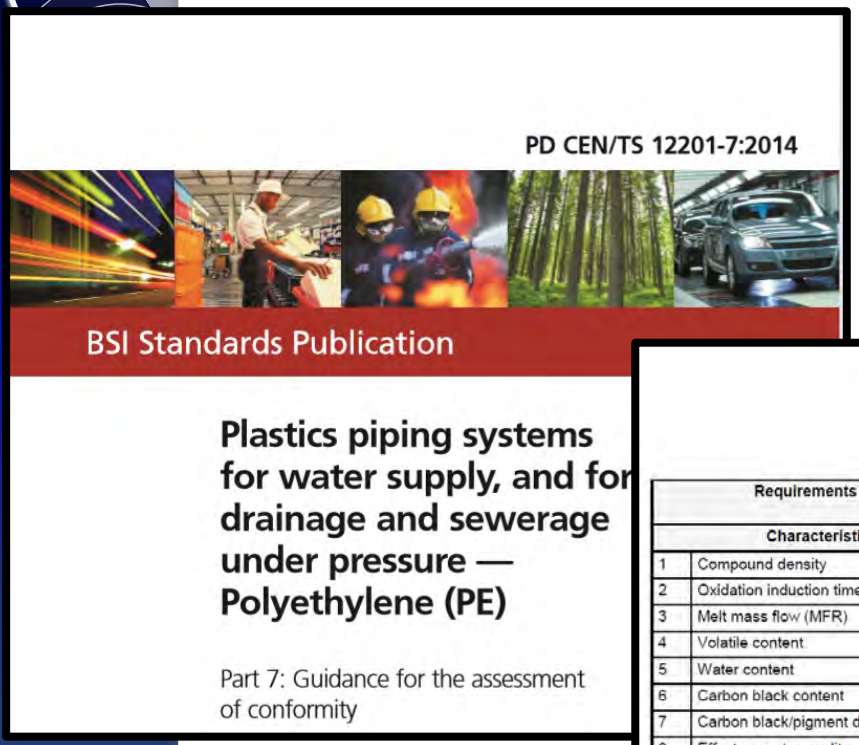
# Conformance Standards

| | | | |
|---|---|---|---|
| PVT | en | : | process verification test |
| | fr | : | essai de vérification du procédé de fabrication |
| | de | : | Prozessüberprüfung |
| TT | en | : | type test |
| | fr | : | essai de type |
| | de | : | Typprüfung |
| WT | en | : | witness test |
| | fr | : | essai témoin |
| | de | : | Prüfung unter Aufsicht |




**Basic test matrix for PE water compounds and piping products**

Table C.1 — Basic test matrix for PE water compounds and piping products

| Requirements for | | compound formulation (by producer) | | | | Pipes | | | | fittings | | | | Valves | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Characteristic | | TT | BRT | PVT | AT | TT | BRT | PVT | AT | TT | BRT | PVT | AT | TT | BRT | PVT | AT |
| 1 | Compound density | X | X | | | | | | | | | | | | | | |
| 2 | Oxidation induction time | X | X | | | X | X | | X | X | | | | X | | | |
| 3 | Melt mass flow (MFR) | X | X | | | X | X | | X | X | | | | X | | | |
| 4 | Volatile content | X | X | | | | | | | | | | | | | | |
| 5 | Water content | X | X | | | | | | | | | | | | | | |
| 6 | Carbon black content | X | X | | | | | | | | | | | | | | |
| 7 | Carbon black/pigment dispersion | X | X | | | | | | | | | | | | | | |
| 8 | Effect on water quality | | | | | X | | | | X | | | | X | | | |
| 9 | Resistance to weathering | X | | | | | | | | | | | | | | | |
| 10 | Resistance to rapid crack propagation | X | | X | X | X (1) | | | X (1) | | | | | | | | |
| 11 | Resistance to slow crack growth | X | | X | X | X(1) | | | X(1) | | | | | | | | |
| 12 | Tensile test on a butt fusion weld | X | | | | | | | | X (7) | | X (7) | X (7) | | | | |
| 13 | Classification | X | | X | X | | | | | | | | | | | | |
| 14 | Appearance | | | | | X | X | | X | X | X | | X | X | X | | X |
| 15 | Colour | | | | | X | X | | X | X | X | | X | X | X | | X |
| 16 | Geometric characteristics | | | | | X | X | | X | X | X | | X | X | X | | X |
| 17 | Hydrostatic strength (20 °C, 100 h) | | | | | X | | | | X | | | | X | | | |
| 18 | Hydrostatic strength (80 °C, 165 h) (2) | | | | | | X | | | | X | | | | X | | |
| 19 | Hydrostatic strength (80 °C, 1 000 h) | | | | | X | | X | X | X | | X | X | X | | X | X |

| | | | |
|---|---|---|---|
| AT | en | : | audit test |
| | fr | : | essai d'audit |
| | de | : | Überwachungsprüfung |
| BRT | en | : | batch release test |
| | fr | : | essai de libération de campagne de fabrication |
| | de | : | Freigabeprüfung einer Charge |
| IT | en | : | indirect test |
| | fr | : | essai indirect |
| | de | : | indirekte Prüfung |

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# Conformance Standards

**type test**
**TT**
test performed to prove that the material, product, joint or assembly is capable of conforming to the requirements given in the relevant standard

Note 1 to entry: The type test results remain valid until there is a change in the material or product or assembly provided that the process verification tests are done regularly.

**batch release test**
**BRT**
test performed by or on behalf of the manufacturer on a batch of compound or products, which is satisfactorily completed before the batch can be released

**process verification test**
**PVT**
test performed by or on behalf of the manufacturer on compound or products or joints or assemblies at specific intervals to confirm that type tests originally performed on the compound or products or joints or assemblies continue to be valid and the process continues to be capable of producing products which conform to the requirements given in the relevant standard

Note 1 to entry: Such tests are not required to release batches of compound or products and are carried out as a measure of process control.

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# Conformance Standards

**audit test**
**AT**
test performed by a test laboratory on behalf of an inspection body or certification body to confirm that the compound, product, joint or assembly continues to conform to the requirements given in the relevant standard and to provide information to assess the effectiveness of the quality management system

**WT**
test accepted by an inspection or a certification body for type testing and/or audit testing, which is carried out by or on behalf of the manufacturer and supervised by a representative of the inspection or certification body, qualified in testing

**sample**
one or more products drawn from the same production batch or lot, selected at random without regard to their quality

Note 1 to entry: The number of products in the sample is the sample size.

Note 2 to entry: The test pieces required for each test are taken from the sample. This information is given in this document, in the product standard or in the relevant test method standard.

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# Sampling Procedures Standards

INTERNATIONAL STANDARD **ISO 28590**

**sampling plan**
specification of the type of sampling to be used combined with the operational specification of the entities or increments to be taken, the samples to be constituted and the measurements to be made

EXAMPLE A specific plan which indicates the type of test, the number of units of products or assemblies to be inspected.

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**Sampling procedures for inspection by attributes — Introduction to the ISO 2859 series of standards for sampling for inspection by attributes**

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# Sampling Procedures Aim

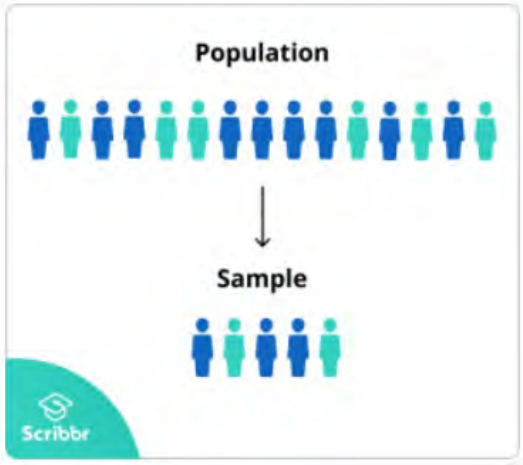
## 4 General introduction to acceptance inspection

### 4.1 Aim of sampling inspection

The principal purpose of acceptance sampling inspection is to see that the producer submits lots of a quality that is at, or better than, a mutually agreed level. All ISO 2859 series standards are based on a common parameter, e.g. AQL or LQ.

The producer may use these sampling procedures to ensure that the quality level will be acceptable to the consumer. In all these procedures, it must be recognized that the financial resources are not unlimited. The cost of the item should reflect the cost of inspection as well as the cost of production.

A real effort shall be made to ensure that a system is devised that clearly places responsibility for quality with the producer. Inspection can appear to divert the responsibility for quality from the producer to the inspector. This may happen whenever there is a belief that the inspector is there to sort things out, so that, within limits, what happens in production will be caught by inspection. Sampling inspection has little effect on the quality of the product lot or batch.

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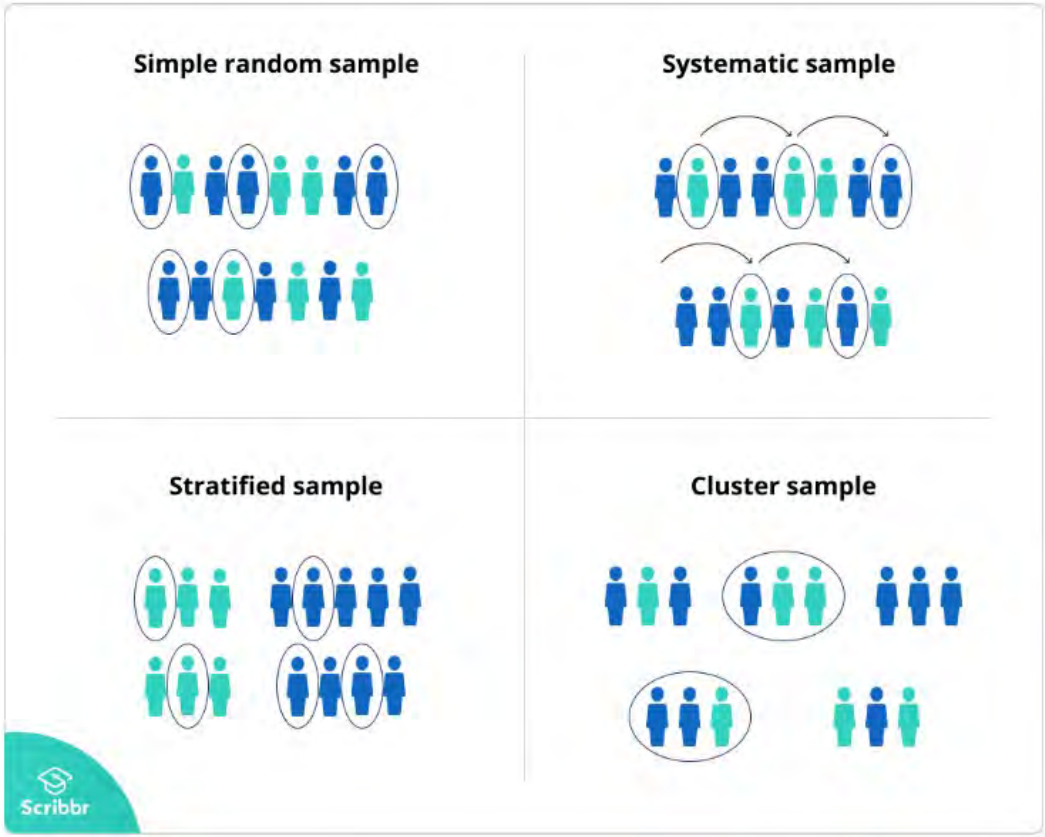
# Sampling Procedures Applicability

Sampling schemes and plans designated in the ISO 2859 series are applicable, but not limited, to inspection of

- end items,
- components and raw materials,
- operations,
- materials in process,
- supplies in storage,
- maintenance operations,
- data or records, and
- administrative procedures.

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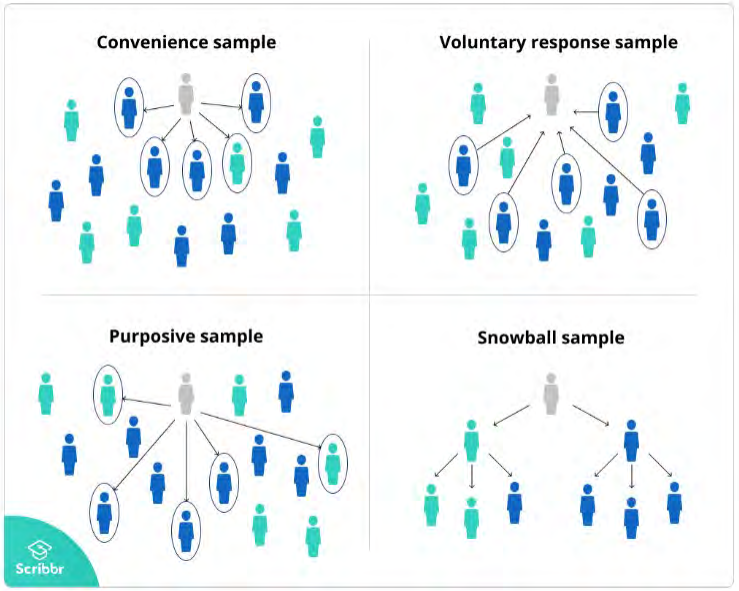
# Sampling Procedures Acceptance Sampling

## 4.2 Acceptance sampling

Acceptance sampling inspection has the merit of putting the responsibility for quality where it belongs, with the producer. The inspector is no longer regarded as the person who corrects errors. The producer must see that the product is of high quality, otherwise there will be inconvenience and expense with unacceptable lots. Sampling inspection can and should lead to less inspection work, lower cost and good quality for the consumer.

The sampling inspection schemes of ISO 2859-1, ISO 2859-2, ISO 2859-3 and ISO 2859-5 provide for quantification of the risk of accepting unsatisfactory product (known as the consumer's risk) and the risk of not accepting satisfactory product (known as the producer's risk), and for choosing a plan that allows no more risk than is acceptable.

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# Sampling Procedures Statistical Sampling

### 4.3.2 Statistical sampling

Sampling based on experience with the product, the process, the producer and the consumer can be statistically evaluated, provided that random sampling and a predefined set of rules for varying sample size and sampling frequency are used.

An example is the procedure described in ISO 2859-1, which uses a set of switching rules. When the quality is very good, it is possible to switch to reduced inspection. This provides a procedure where, if smaller samples are used, the producer's risk is reduced but the consumer's risk is increased. If the process average is consistently smaller than the specified acceptance quality limit (AQL), this is justified. When the process average over at least 10 lots has been very much smaller than the AQL, some consumers resort to skip-lot procedures (see ISO 2859-3). This can be even more economical than the reduced inspection described in ISO 2859-1.

In some instances, particularly when routine or non-critical items are involved, some consumers may feel safe in resorting to the practice of inspecting small samples of the product and, provided there are zero nonconforming items, accepting the lot. For example, a sample size of eight with an acceptance number of zero is equivalent to the small lot sampling plans with an AQL of 1,5 % normal, or 0,65 % reduced inspection. See Tables 2-A and 2-C in ISO 2859-1:1999.

Conversely, in ISO 2859-1, when two out of five or fewer successive lots fail inspection, normal inspection is discontinued and tightened inspection is instituted. Once tightened inspection has been instituted, normal inspection is not restored until five successive lots have been accepted on tightened inspection. This requirement is intentionally severe, because evidence of unacceptable quality has been found, as a result of which, the producer forfeits the right to the benefit of the doubt. If, while operating on tightened inspection, the cumulative number of lots not accepted on original tightened inspection reaches five, inspection by sampling shall be discontinued until there is evidence that corrective action has been taken and has been fully effective.

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# Sampling Procedures Ad Hoc Sampling

### 4.3.3 Ad hoc sampling

Ad hoc sampling should not be used because it will lead to unknown risks that may be too high. Furthermore, there is no formal basis for either the acceptance or non-acceptance of the lot. Examples of ad hoc sampling include sampling of a fixed percentage of a lot or a convenience sample taken at haphazard times.

## Static reports vs. ad hoc analysis

Ad hoc analysis tools enable business users to answer queries not addressed by static reports. Here's how the two formats differ:

| STATIC REPORT | AD HOC ANALYSIS |
|---|---|
| Automated and produced regularly | Produced once |
| Developed by an analyst | Run by a user |
| Reports on ongoing activity | Answers a specific question |
| More formatted, with text and tables | More visual |
| Distributed to larger audience | Shared with smaller audience |

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# Sampling Procedures 100% Inspection

### 4.3.4 100 % inspection

100 % inspection can be a formidable task unless it is performed with automatic test equipment, or lot sizes are small. In addition, it is not always fully effective, particularly when a large number of items have one or more characteristics that are marginal in appearance, performance or dimension (close to or concentrated about a tolerance or limit of appearance or performance). Sampling inspection may be done with more care and is less prone to the effects of human fatigue. Under these conditions, sorting by manual or automatic methods is likely to classify some conforming items as nonconforming and vice versa. In addition, 100 % inspection can sometimes degenerate into superficial 100 % inspection when, in fact, sufficient money, time and staff are not available. In addition, 100 % inspection is not viable if the inspection method necessitates destruction of the product. It has to be understood, however, that 100 % inspection may form a necessary part of the inspection process for both the consumer and the producer, or a rejected lot must be screened to remove nonconforming product. There are situations in which it cannot be avoided, for example, when inspecting for critical nonconformities that are so important that every item must be examined when inspections are non-destructive. When inspection is destructive, some risks are inevitable.



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# Sampling Procedures Standards

**4.3.5 Other sampling practices**

Various sampling systems exist, but only those available as international standards in the ISO 2859 series will be considered in detail in this International Standard. This does not mean that the others are not important. It is merely that the main purpose of this International Standard is to introduce the ISO 2859 family of standards.

In many instances, consumers do not perform any regular sampling but rely on their experience and past sampling evidence that the producer is maintaining statistical control of the production process and is forthright in the evaluation of what is being shipped.

If, in a particular situation, information is available of the true costs of the mistaken non-acceptance of good articles and the acceptance of bad ones, and if it is known how often lots of any given quality are presented, this may be one of the occasions when it would be better to determine a more efficient scheme on the basis of the economic information available. In such instances, it is possible to develop sampling plans that are more cost-effective than those in the ISO 2859 series. ISO/TR 8550-1 includes procedures for developing such plans.


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# Statistical Method Standards

**ISO Standards collection**

## Statistical methods

### Contents

| | |
|---|---|
| ISO 2602:1980 | Statistical interpretation of t<br>Confidence interval |
| ISO 2854:1976 | Statistical interpretation of d<br>relating to means and varia |
| ISO 2859-1:1999 | Sampling procedures for ins<br>schemes indexed by accep |
| ISO 2859-1:1999 / Cor. 1:2001 | Technical Corrigendum 1:2 |
| ISO 2859-2:1985 | Sampling procedures for ins<br>indexed by limiting quality ( |
| ISO 2859-3:2005 | Sampling procedures for ins<br>procedures |
| ISO 2859-4:2002 | Sampling procedures for ins<br>assessment of declared qu |
| ISO 2859-5:2005 | Sampling procedures for ins<br>sequential sampling plans i<br>by-lot inspection |
| ISO 2859-10:2006 | Sampling procedures for ins<br>the ISO 2859 series of stan |
| ISO 3301:1975 | Statistical interpretation of data -- Comparison of two means in the case of paired observations |
| ISO 3494:1976 | Statistical interpretation of data -- Power of tests relating to means and variances |
| ISO 3534-1:2006 | Statistics -- Vocabulary and symbols -- Part 1: General statistical terms and terms used in probability |
| ISO 3534-2:2006 | Statistics -- Vocabulary and symbols -- Part 2: Applied statistics |
| ISO 3534-3:1999 | Statistics -- Vocabulary and symbols -- Part 3: Design of experiments |
| ISO 3951-1:2005 | Sampling procedures for inspection by variables -- Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL |
| ISO 3951-2:2006 | Sampling procedures for inspection by variables -- Part 2: General specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection of independent quality characteristics |
| ISO 3951-3:2007 | Sampling procedures for inspection by variables -- Part 3: Double sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection |
| ISO 3951-5:2006 | Sampling procedures for inspection by variables -- Part 5: Sequential sampling plans indexed by acceptance quality limit (AQL) for inspection by variables (known standard deviation) |
| ISO 5479:1997 | Statistical interpretation of data -- Tests for departure from the normal distribution |
| ISO 5725-1:1994 | Accuracy (trueness and precision) of measurement methods and results -- Part 1: General principles and definitions |
| ISO 5725-1:1994 / Cor. 1:1998 | Technical Corrigendum 1:1998 to ISO 5725-1:1994 |
| ISO 5725-2:1994 | Accuracy (trueness and precision) of measurement methods and results -- Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method |
| ISO 5725-2:1994 / Cor. 1:2002 | Technical Corrigendum 1:2002 to ISO 5725-2:1994 |
| ISO 5725-3:1994 | Accuracy (trueness and precision) of measurement methods and results -- Part 3: Intermediate measures of the precision of a standard measurement method |
| ISO 5725-3:1994 / Cor. 1:2001 | Technical Corrigendum 1:2001 to ISO 5725-3:1994 |
| ISO 5725-4:1994 | Accuracy (trueness and precision) of measurement<br>Part 4: Basic methods for the determination of the tr<br>measurement method |
| ISO 5725-5:1998 | Accuracy (trueness and precision) of measurement<br>Part 5: Alternative methods for the determination of<br>standard measurement method |
| ISO 5725-5:1998 / Cor. 1:2005 | Technical Corrigendum 1:1998 to ISO 5725-5:1998 |
| ISO 5725-6:1994 | Accuracy (trueness and precision) of measurement<br>Part 6: Use in practice of accuracy values |
| ISO 5725-6:1994 / Cor. 1:2001 | Technical Corrigendum 1:2001 to ISO 5725-6:1994 |
| ISO 7870-1:2007 | Control charts -- Part 1: General guidelines |
| ISO/TR 7871:1997 | Cumulative sum charts -- Guidance on quality contr<br>using CUSUM techniques |
| ISO 7873:1993 | Control charts for arithmetic average with warning li |
| ISO 7966:1993 | Acceptance control charts |
| ISO 8258:1991 | Shewhart control charts |
| ISO 8258:1991 / Cor. 1:1993 | Technical Corrigendum 1:1993 to ISO 8258:1991 |
| ISO 8422:2006 | Sequential sampling plans for inspection by attribute |
| ISO 8423:1991 | Sequential sampling plans for inspection by variable<br>nonconforming (known standard deviation) |
| ISO 8423:1991 / Cor. 1:1993 | Technical Corrigendum 1:1993 to ISO 8423:1991 |
| ISO/TR 8550-1:2007 | Guidance on the selection and usage of acceptance<br>inspection of discrete items in lots -- Part 1: Accepta |
| ISO/TR 8550-2:2007 | Guidance on the selection and usage of acceptance<br>inspection of discrete items in lots -- Part 2: Samplin |
| ISO/TR 8550-3:2007 | Guidance on the sele<br>inspection of discrete |
| ISO/TR 10017:2003 | Guidance on statistica |
| ISO 10576-1:2003 | Statistical methods -- Guidelines for the evaluation of conformity with specified requirements -- Part 1: General principles |
| ISO 10725:2000 | Acceptance sampling plans and procedures for the inspection of bulk materials |
| ISO 11095:1996 | Linear calibration using reference materials |
| ISO 11453:1996 | Statistical interpretation of data -- Tests and confidence intervals relating to proportions |
| ISO 11453:1996 / Cor. 1:1999 | Technical Corrigendum 1:1999 to ISO 11453:1996 |
| ISO 11462-1:2001 | Guidelines for implementation of statistical process control (SPC) -- Part 1: Elements of SPC |
| ISO 11648-1:2003 | Statistical aspects of sampling from bulk materials -- Part 1: General principles |
| ISO 11648-2:2001 | Statistical aspects of sampling from bulk materials -- Part 2: Sampling of particulate materials |
| ISO 11843-1:1997 | Capability of detection -- Part 1: Terms and definitions |
| ISO 11843-1:1997 / Cor. 1:2003 | Technical Corrigendum 1:2003 to ISO 11843-1:1997 |
| ISO 11843-2:2000 | Capability of detection -- Part 2: Methodology in the linear calibration case |
| ISO 11843-2:2000 / Cor. 1:2007 | Technical Corrigendum 1:2007 to ISO 11843-2:2000 |
| ISO 11843-3:2003 | Capability of detection -- Part 3: Methodology for determination of the critical value for the response variable when no calibration data are used |
| ISO 11843-4:2003 | Capability of detection -- Part 4: Methodology for comparing the minimum detectable value with a given value |
| ISO/TR 13425:2006 | Guidelines for the selection of statistical methods in standardization and specification |
| ISO 13448-1:2005 | Acceptance sampling procedures based on the allocation of priorities principle (APP) -- Part 1: Guidelines for the APP approach |
| ISO 13448-2:2004 | Acceptance sampling procedures based on the allocation of priorities principle (APP) -- Part 2: Coordinated single sampling plans for acceptance sampling by attributes |
| ISO 13528:2005 | Statistical methods for use in proficiency testing by interlaboratory comparisons |
| ISO 14560:2004 | Acceptance sampling procedures by attributes -- Specified quality levels in nonconforming items per million |
| ISO 16269-6:2005 | Statistical interpretation of data -- Part 6: Determination of statistical tolerance intervals |
| ISO 16269-7:2001 | Statistical interpretation of data -- Part 7: Median -- Estimation and confidence intervals |
| ISO 16269-8:2004 | Statistical interpretation of data -- Part 8: Determination of prediction intervals |
| ISO 18414:2006 | Acceptance sampling procedures by attributes -- Accept-zero sampling system based on credit principle for controlling outgoing quality |
| ISO 21247:2005 | Combined accept-zero sampling systems and process control procedures for product acceptance |
| ISO 21747:2006 | Statistical methods -- Process performance and capability statistics for measured quality characteristics |
| ISO/TS 21748:2004 | Guidance for the use of repeatability, reproducibility and trueness estimates in measurement uncertainty estimation |
| ISO/TS 21749:2005 | Measurement uncertainty for metrological applications -- Repeated measurements and nested experiments |
| ISO 22514-3:2008 | Statistical methods in process management -- Capability and performance -- Part 3: Machine performance studies for measured data on discrete parts |
| ISO/TR 22514-4:2007 | Statistical methods in process management -- Capability and performance -- Part 4: Process capability estimates and performance measures |
| ISO/TR 22971:2005 | Accuracy (trueness and precision) of measurement methods and results -- Practical guidance for the use of ISO 5725-2:1994 in designing, implementing and statistically analysing interlaboratory repeatability and reproducibility results |
| ISO/TR 29901:2007 | Selected illustrations of full factorial experiments with four factors |

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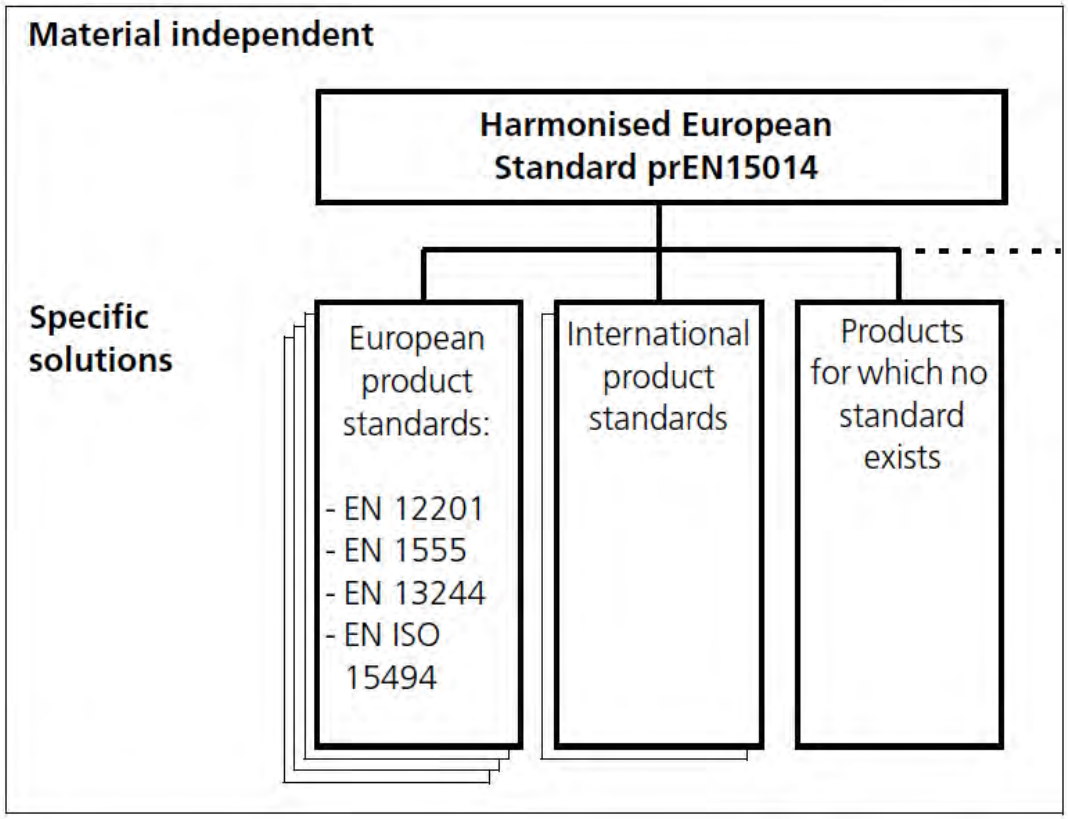
# Harmonized Standards

The harmonised European standard belongs to a family or cluster of standards aimed at plastic pipe systems. The relationship is shown in figure 4.1.




| European product standards for PE pipe systems | |
|---|---|
| EN 12201 | Plastic pipe systems for water supply - Polyethylene (PE) |
| EN 1555 | Plastic pipe systems for the supply of gaseous fuels - Polyethylene (PE) |
| EN 13244 | Plastic pipe systems for buried and aboveground pressure systems for general purpose water, drainage and sewerage - Polyethylene (PE) - Part 1: General |
| EN ISO 15494 | Plastic pipe systems for industrial applications - Polybutene (PB), Polyethylene (PE), Polypropylene (PP) - Specifications for components and the system - Metric series |

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# Standards

- Standards capture what may be regarded as best practice in a particular field.
- The information in standards has been vetted by those deemed to be experts, (Legitimate authority in the absence of anything more appropriate)
- They are but one of several sources of authoritative information

# What exactly is sustainable quality management?

The term management refers to:

All the activities that are used to coordinate, direct, and control an organisation. In this context, the term management does not refer to people. It refers to activities.

ISO 9001 uses the term top management to refer to people.

A management system refers to:

A set of interrelated or interacting processes that organisations use to implement policy and achieve objectives.

One definition of sustainable quality management systems:

Those systems that cover the whole life of the product and which do so in a manner that enables them to be successfully implemented in the long term

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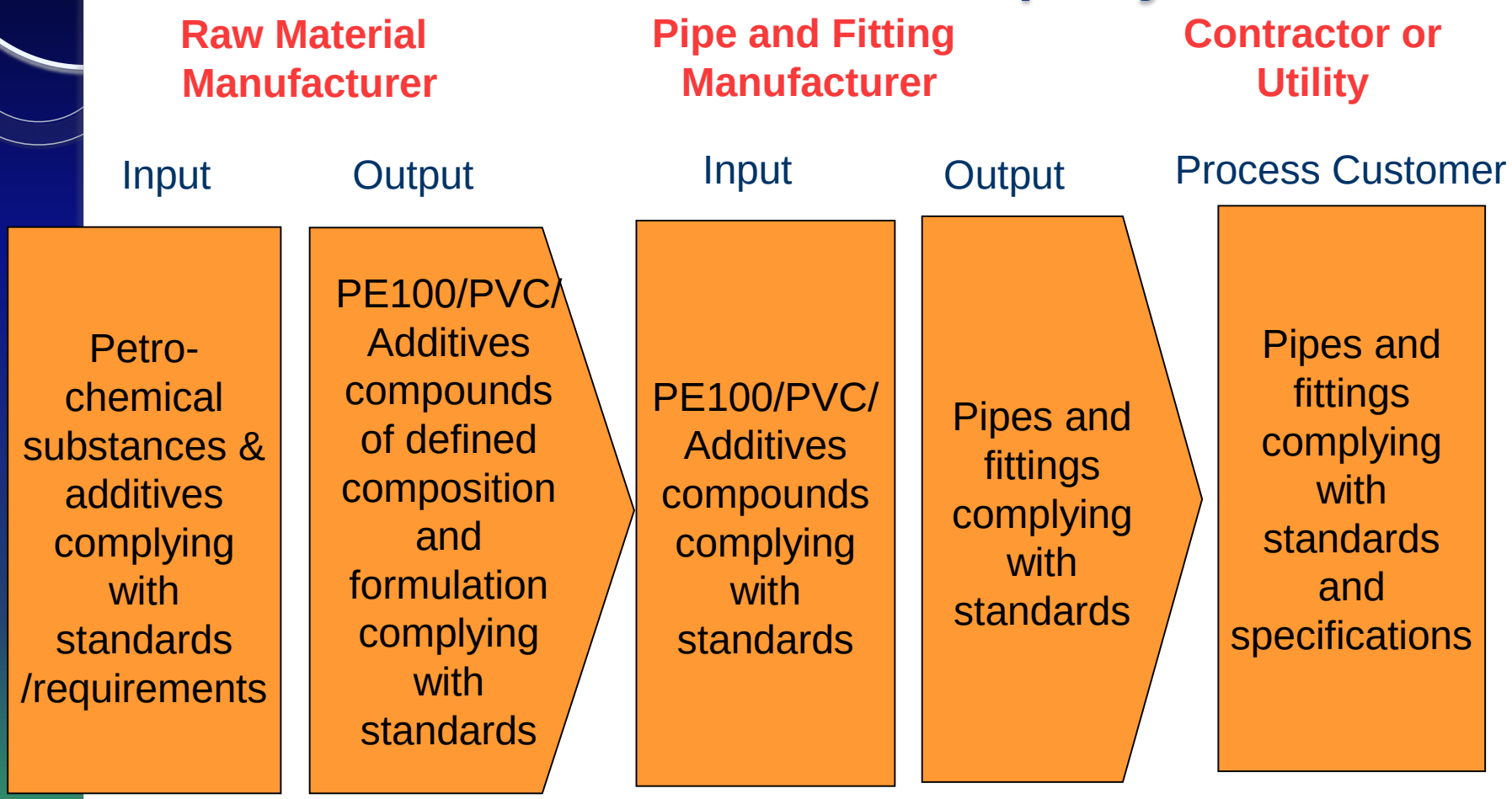
# The manufacturing process overview for a utilities project

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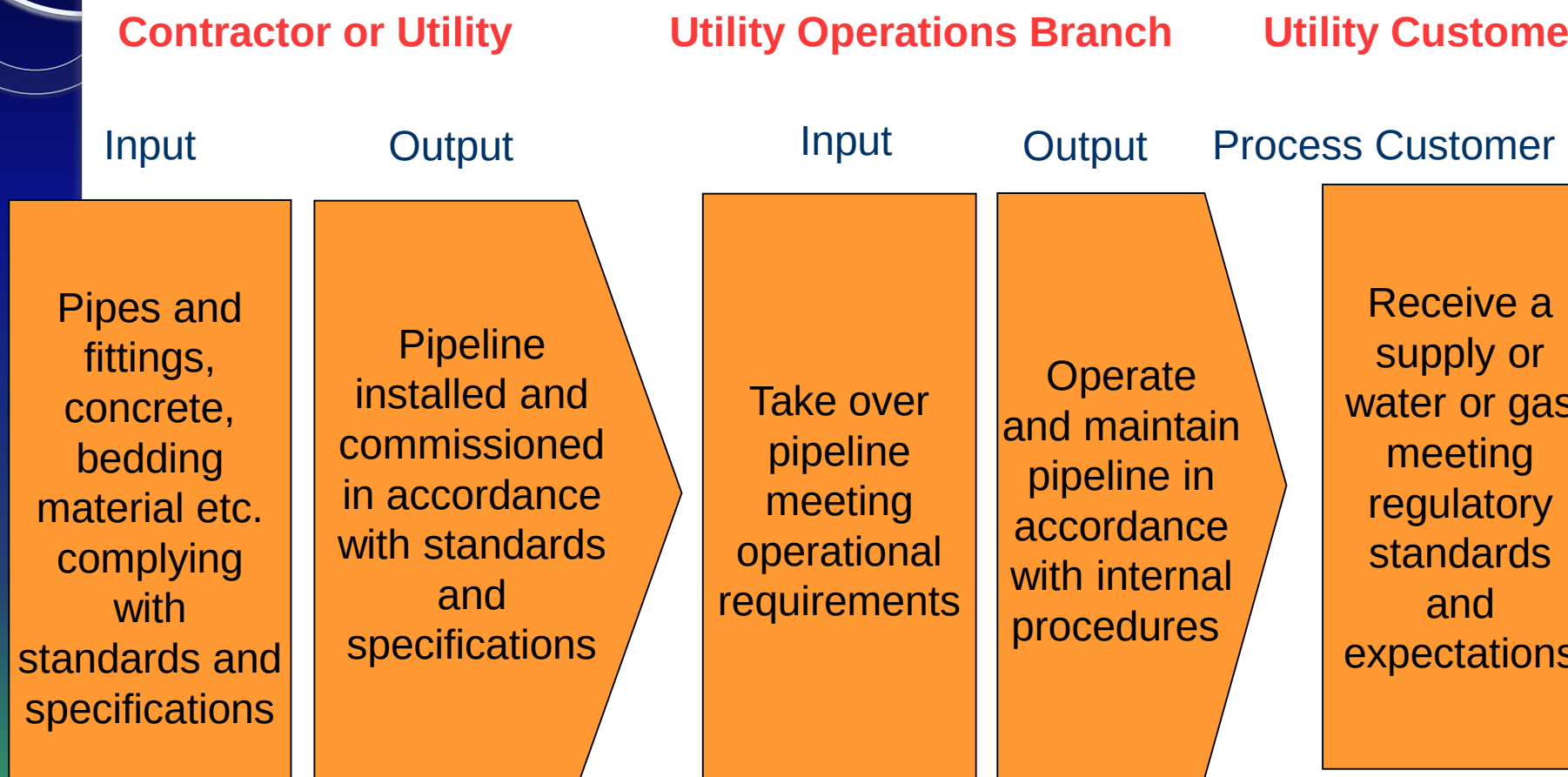
# The installation and operation process overview for a utilities project

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# A series of strong Quality Management Systems provide the links

Does your pipe producer have ISO 9001 certification? If so they should have quality management systems (QMS) which should be implemented at each stage of the manufacturing, installation and operation process.

There should be continuity between the different QMS, which, where possible, should refer to common standards.
The QMS requirements and associated specifications etc. should be tied in to international standards (ISO) whenever possible.


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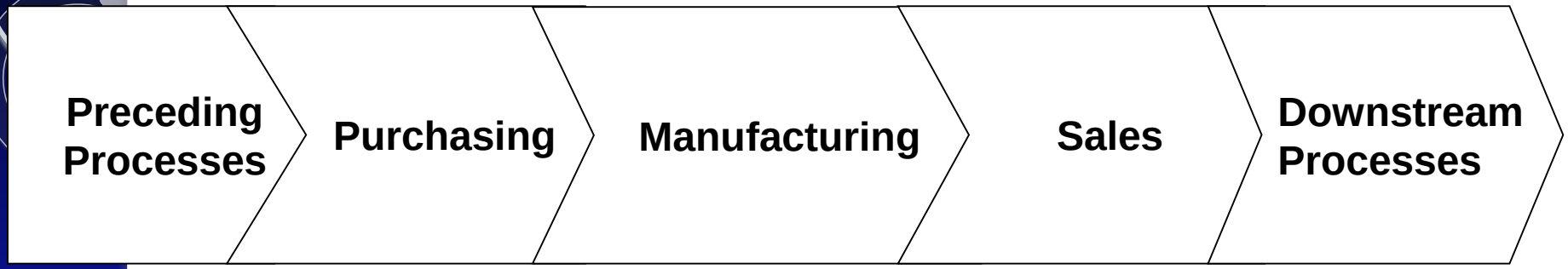
# Raw material manufacturer key QMS




QMS according to ISO 9001

Compliance with international regulations eg. ISO/SANS/Company procedures

In compliance with any national regulations eg. SANS/SABS/SATAS Permit conditions

Regularly audit suppliers

QMS according to ISO 9001

Comprehensive AoC system
eg. SATAS

Having 3rd party certification for the compounds – PE100+/ PVC formulations

In compliance with any national regulations

PVT –Process Verification tests

QMS according to ISO 9001

Fully documented shipments inc. 3rd party

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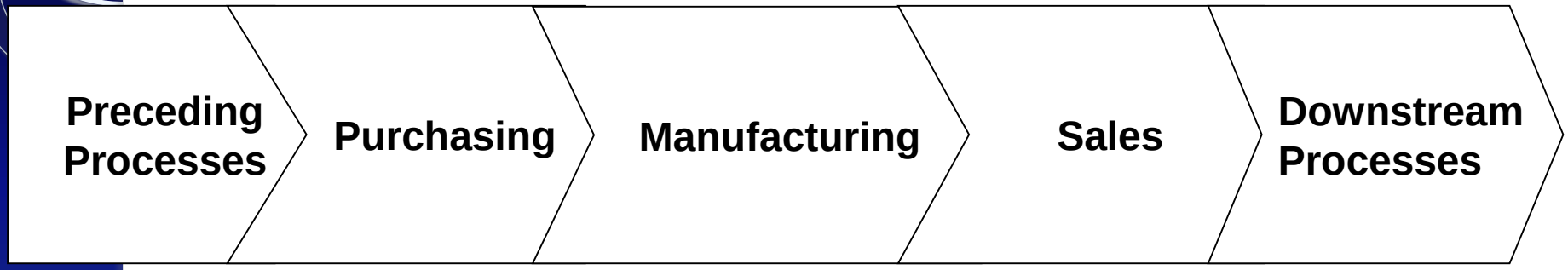
# Pipe and fitting manufacturer key QMS




| Preceding Processes | Purchasing | Manufacturing | Sales | Downstream Processes |
|---|---|---|---|---|
| QMS according to ISO 9001 | QMS according to ISO 9001 | QMS according to ISO 9001 | Offer full package of jointing tools |
| Consider 3rd party approved lists e.g. PE100+ | Comprehensive AoC system eg. SATAS | Pipes to be marked as per standards | Offer on site support for large projects |
| Fully documented shipments inc. 3rd party certificates | Having 3rd party certification eg. Quality Marks | Fully documented shipments inc. 3rd party | Provide practical training for contractors and end users |
| Regularly audit raw material manufacturer | Use traceability code - ISO 12176-4 | | |

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# The Quality Plan

A document that describes the standards, quality practices, resources and processes related to a particular product or activity

This is the key document within the QMS that describes how the different elements fit together to deliver a quality product or service

Quality plans related to manufacturing processes contain a lot of information concerning what inspection and testing is undertaken to assess whether the product is confirming to the required standards and manufacturing requirements

If the manufacturer is a member of a conformity assessment scheme then the contents of the quality plan must, as a minimum, comply with the requirements of the scheme.


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# Design systems /Component

- Designing a process for product

## Ideal Process Model

Monitoring and Measuring

Input
Requirements Specified (Including resources)

Interrelated or interacting activities and control methods

Output
Requirements Satisfied (Results of a process)

Effectiveness of Process = Ability to achieve the desired result

Efficiency of the of Process = Results achieved vs resources used

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# Aspects to consider for inclusions

- Simplified Flow diagram
- Approved Samples
- Specification sheets, QC checklists
- Potential Defects
- Contracts
- Sample Reviews
- Product inspections

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# Do you know what makes it work?


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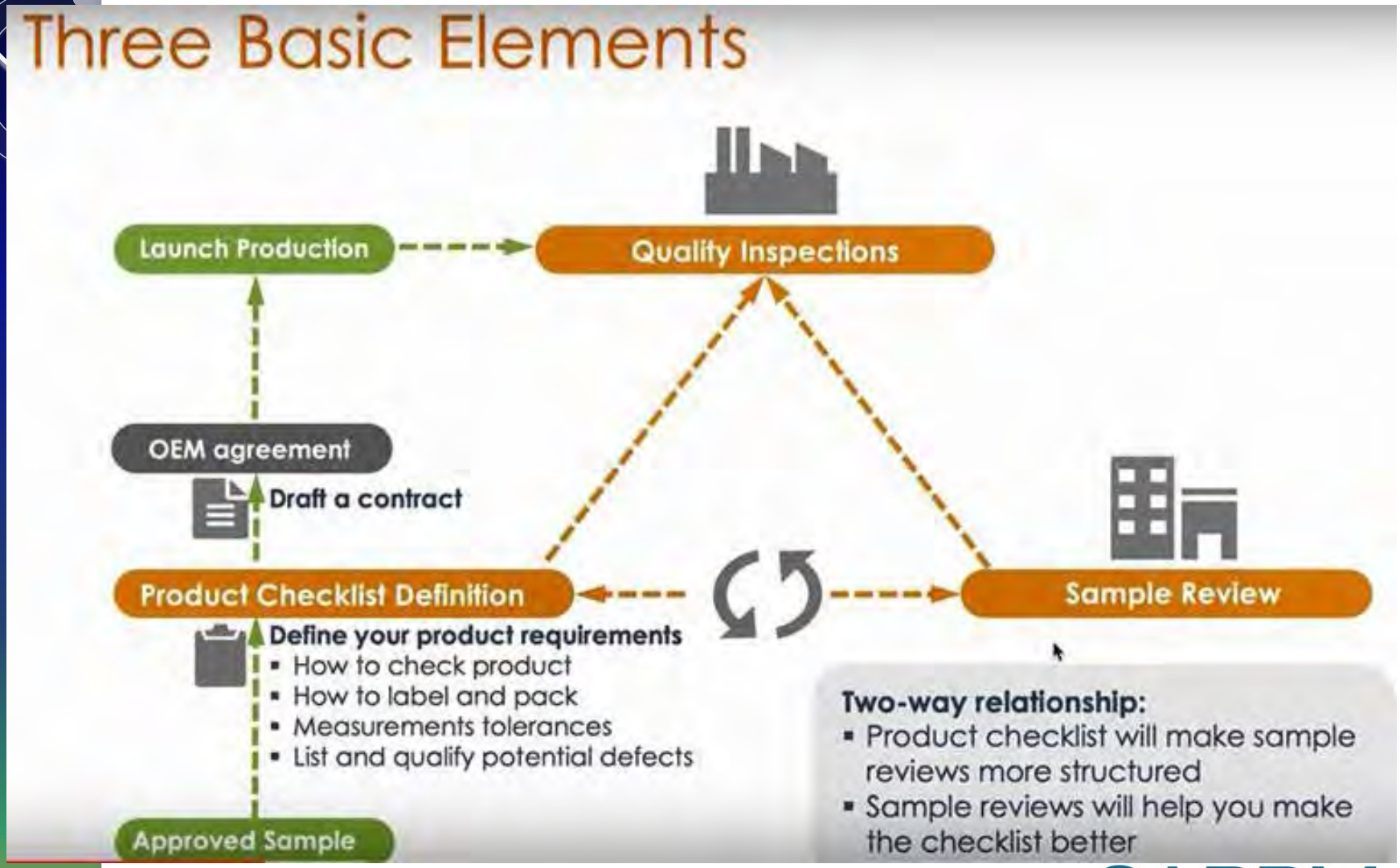
# Does your supplier satisfy your needs?

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# Samples


Perform critical and specific Type Testing
Perform comparative tests if needed
Design Batch Release and Process Verification tests

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# Specification Sheets

Clear and Concise summary of what is CTQ Critical to Quality

## The Role of the Specification Sheet

- Set the expectations in the necessary level of detail.
- Set an agreed-on standard and a checklist for QC inspections.

## How to write a functional specifications document

Depending on the project and the team, a functional specification could include the following:

- **Project scope.** This covers the goals, features, tasks, deliverables, costs and deadlines of the project.
- **Risks and assumptions.** These are considerations that could affect the functional design of the product.
- **Product overview.** This explains how the application will solve a specific problem for the target audience.
- **Use cases.** The functional requirements are placed in the context of a user action. This shows what happens from the user perspective.
- **Requirements.** These essential features of the product explain what it does.
- **Configuration.** This details steps needed to configure a product, such as user account setup.
- **Nonfunctional requirements.** These are nonessential features that aren't at the core of the product.
- **Error reporting.** This is an explanation of how the product will handle errors or exceptions.

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# Clarification in Advance

## Clarify Requirements in Advance!

Imagine the following scenario:

1. A supplier shows you a nice sample
2. You wire a deposit
3. Production takes place
4. You notice some issues you cannot accept
5. The supplier believes it is acceptable
   - "The issue you mention is quite minor"
   - "All our other customers accept it"
   - …

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# Specification Sheet

## What Is in a Specification Sheet?

A good specification sheet includes at least the following elements:

1. What is expected, and how the product needs to be checked
2. What tolerances you should apply to measurements
3. How the product should be labelled and packed
4. What the potential defects are and how to classify them


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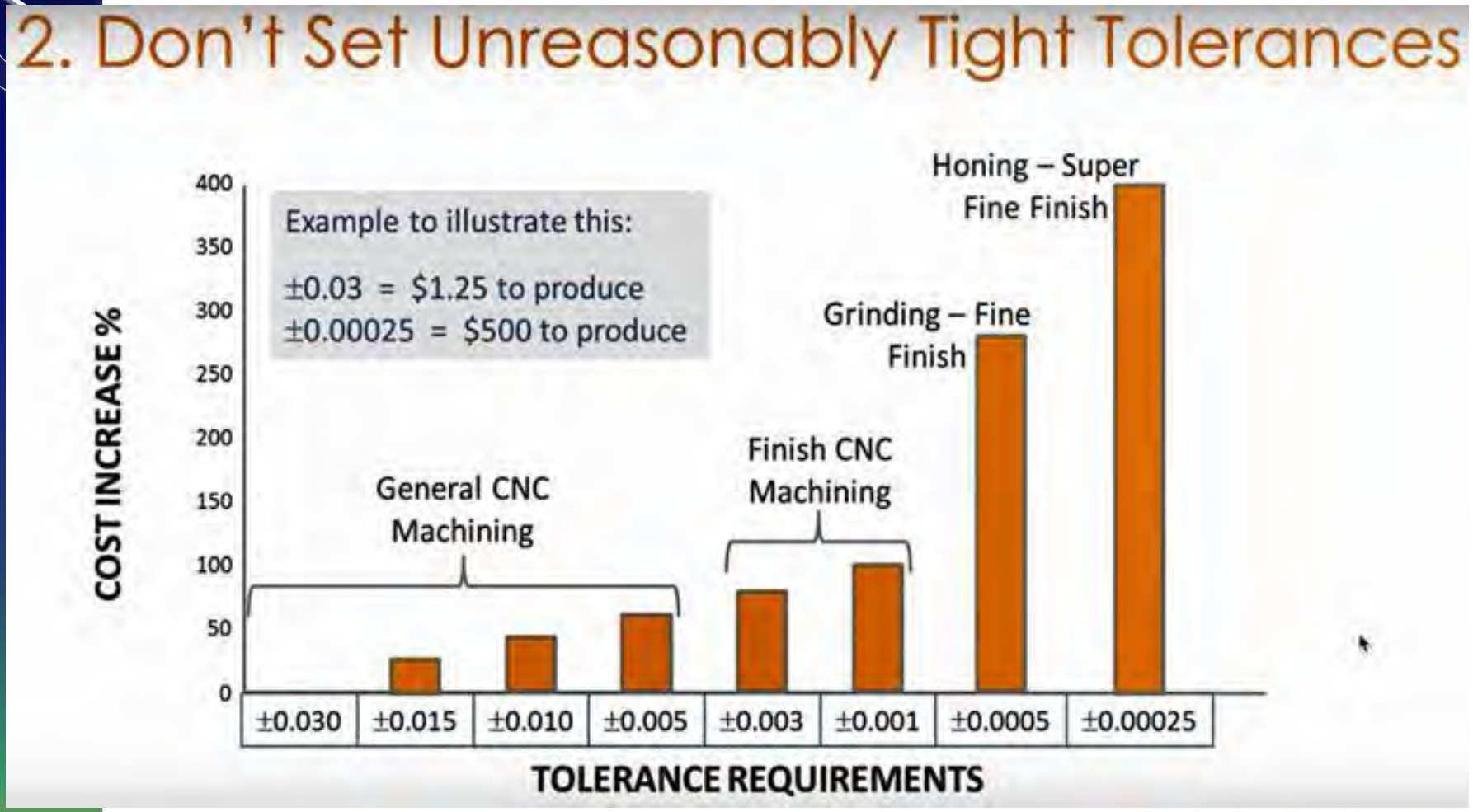
# What is expected

| Checkpoint | Requirement |
|---|---|
| System Component Drawings | All drawings details needed to allow for layout drawings of the system E.g. Hight Width Length as well as tolerances. |
| Dimensional  Component Technical Drawings | QC of all critical dimensions, allowing for measurements forming part of sampling plans including critical Tolerances. |
| Finished Goods, Assembly Technical drawings and details   | Detailed positioning of components in relationship to one another to complete a product. Product positioning and jointing in relation to other product related to the method of jointing and the system application. Gasketing and Torqueing and alignment requirements need to be reflected or referred to |
| Mass of critical components and Total Net Weight of the assembled product | Mass of components and assembled product with tolerance |

# Tolerances can cost you

Know what the UCL and LCL for critical points need to be




UCL- Upper Control Limit
LCL- Lower Control Limit

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# Potential Defects Chart

## 4. Potential Defects

| DESCRIPTION OF DEFECT | CATEGORY | | |
|---|---|---|---|
| | CRITICAL | MAJOR | MINOR |
| The sample color should match the signed sample. | | ✓ | |
| There shouldn't be any insects or hair in the package or product. | ✓ | | |
| Pitting, blemish, scratches, strain, all parts need to be kept clean. | | | |
| a. Pitting, stains (can be cleaned), scratches (less than 8mm) counted as Minor; | | | ✓ |
| b. Scratches (more than 8mm), stains (can't be cleaned), counted as Major; | | ✓ | |
| Excessive flash (more than 1mm), count it as major, otherwise, count it as minor. | | ✓ | ✓ |
| If anything is wet (products, packaging), count it as critical. | ✓ | | |

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# Photos

## Photo illustrations

| | | | | |
|---|---|---|---|---|
| 3 Notches and flutes   | Notches in the edge of the base material, lengthwise or crosswise to weld, caused, for example, by:<br>– clamping tools;<br>– incorrect transport; or<br>– faulty edge preparation | Locally permissible if ending of notch is flat and $\Delta s \leq 0{,}1s$, with a maximum of 0,5 mm | Locally permissible if ending of notch is flat and $\Delta s \leq 0{,}1s$, with a maximum of 1 mm | Locally permissible ending of notch is and $\Delta s \leq 0{,}1s$, with maximum of 2 mm |

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# Design your Measurement System

- Purpose:
- We are looking to establish a baseline performance for the current processes and over time we want to develop improvements of the performance of the process.
- What input, process, output info will be Critical To Quality (CTQ)
- What is a defect, unit, and opportunity that can be obtained from the measurement system.
- What is your data collection plan? How much data did you collect? How did you sample?
- What did you do to ensure the reliability and validity of the measurement process?
- Can you graphically display the data such that you can work with the outcome?
- What is the current status of the outcomes, to what action does it lead.

# Agree on AQL

- The acceptable quality limit (**AQL**) is the worst tolerable process average (mean) in percentage or ratio that is still considered acceptable; that is, it is at an acceptable quality level. Closely related terms are the rejectable quality limit and rejectable quality level (RQL).

# AQL at a glance

## Acceptance Limits for Defects

The acceptance limits for most consumer goods are generally defined as:

- 0% for critical defects (a user might get harmed, or regulations are not respected).
- 2.5% for major defects (usually not be considered acceptable by the end user). *Sometimes 1.5%, 1.0%, or 0.65%.*
- 4.0% for minor defects (not perfect, but most users would not mind it very much). *Sometimes 2.5%.*

# Design your Contract

## Typical Terms

What to include in your contract with your supplier:

- Quality inspections of products, random or in full
- Conducted based on the ISO2859-1 standard (normal severity, level to be determined as we see fit)
- Acceptance quality limit (AQL) is 0% for critical defects, 2.5% for major defects, 4.0% for minor defects
- By our own team or an independent agency that we nominate
- Defects to be classified as per attached defect list
- Production to be as per approved sample and attached QC checklist
- In case of failure, the cost of the re-inspection(s) will be deducted from the balance of the payment to the supplier

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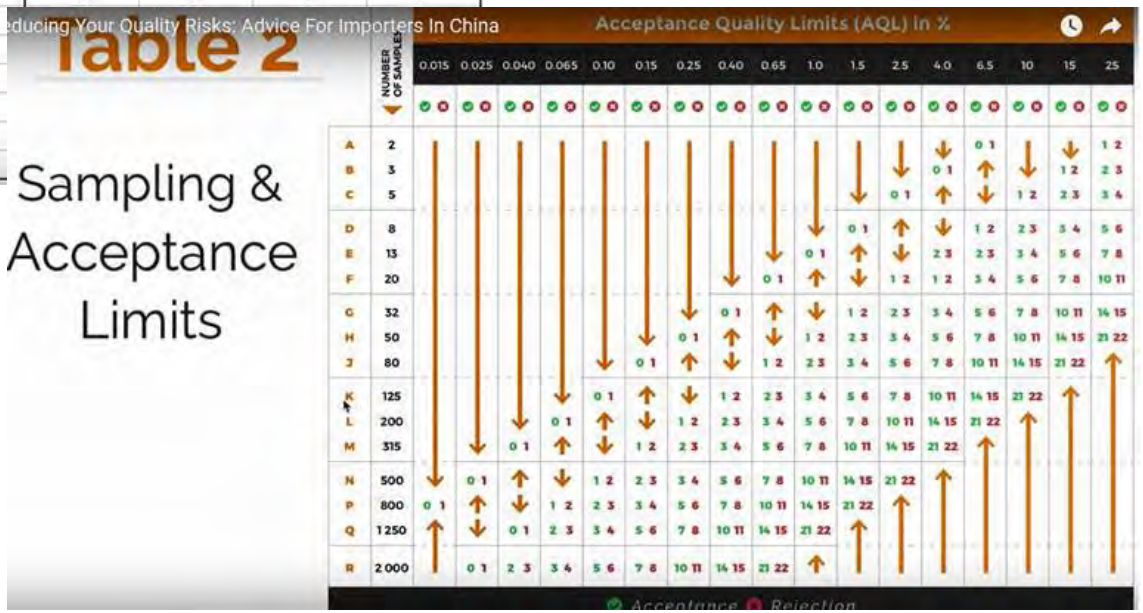
# Determine method of inspection (Third Party independent, number of samples and pass-fail allowances)

| Lot size (Number of ordered products) | General Inspection Levels | | | Special Inspection Levels | | | |
|---|---|---|---|---|---|---|---|
| | I | II | III | S-1 | S-2 | S-3 | S-4 |
| 2 → 8 | A | A | B | A | A | A | A |
| 9 → 15 | A | B | C | A | A | A | A |
| 16 → 25 | B | C | D | A | A | B | B |
| 26 → 50 | C | D | E | A | B | B | C |
| 51 → 90 | C | E | F | B | B | C | C |
| 91 → 150 | D | F | G | B | B | C | D |
| 151 → 280 | E | G | H | B | C | D | E |
| 281 → 500 | F | H | J | B | C | D | E |
| 501 → 1 200 | G | J | K | C | C | E | F |
| 1 201 → 3 200 | H | K | L | | | | |
| 3 201 → 10 000 | J | L | M | | | | |
| 10 001 → 35 000 | K | M | N | | | | |
| 35 001 → 150 000 | L | N | P | | | | |
| 150 001 → 500 000 | M | P | Q | | | | |
| 500 001 → 10000000 | N | Q | R | | | | |

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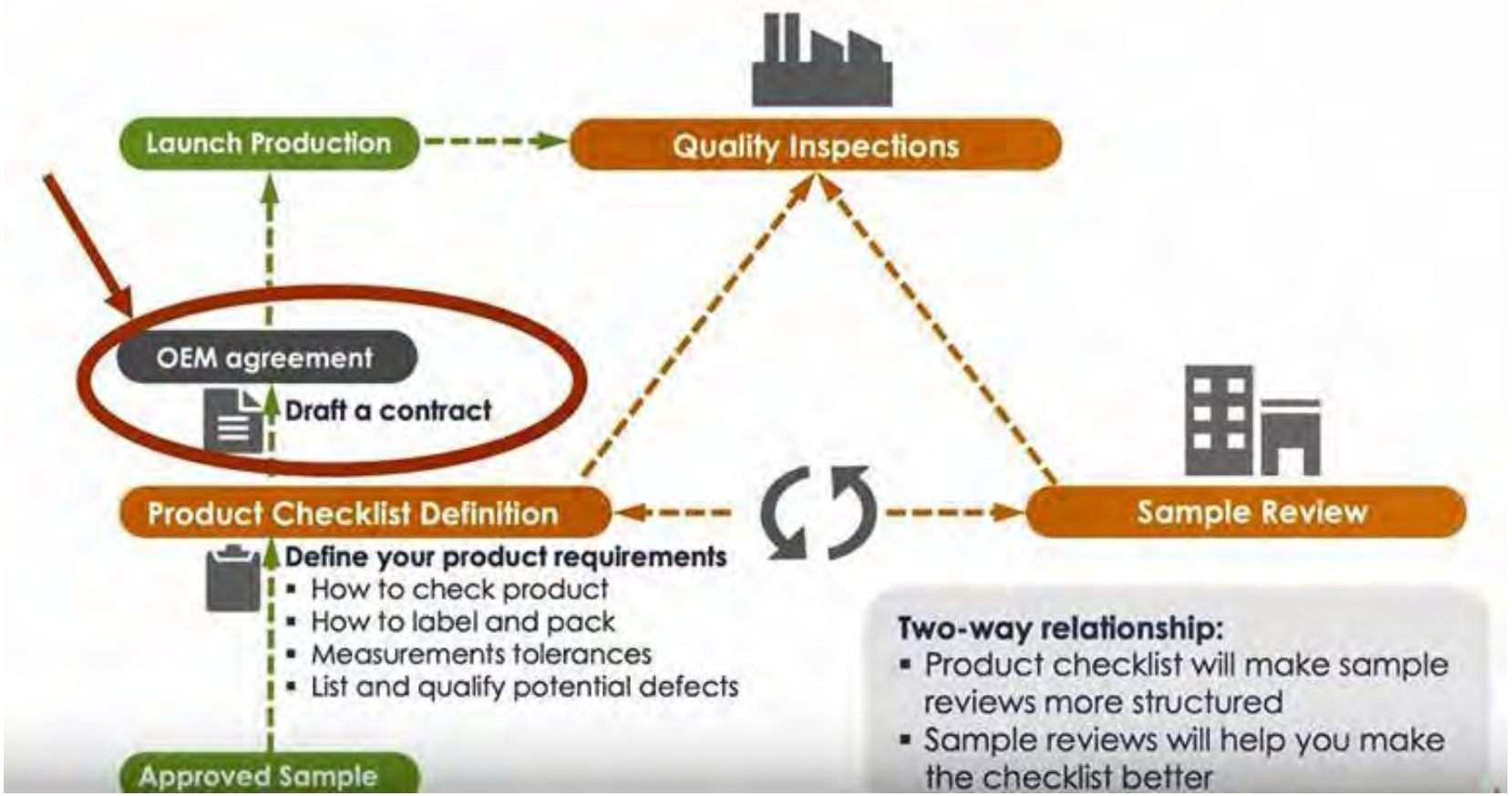
# Determine Line Sampling Frequencies

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# Samples

## Sample Reviews

Usually take place at 2 stages:

- Before production – for approval, to make sure the factory understands what the client wants.
  - Beware: samples are tools for selling!
- During production – to ensure no widespread issue in production.
  - Beware: samples are carefully selected, and sometimes made separately!

# Update your SMART system


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# Do you now what is required?

## At the Factory?

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# Do not wait till it is too late, plan.


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# Final Random Inspection

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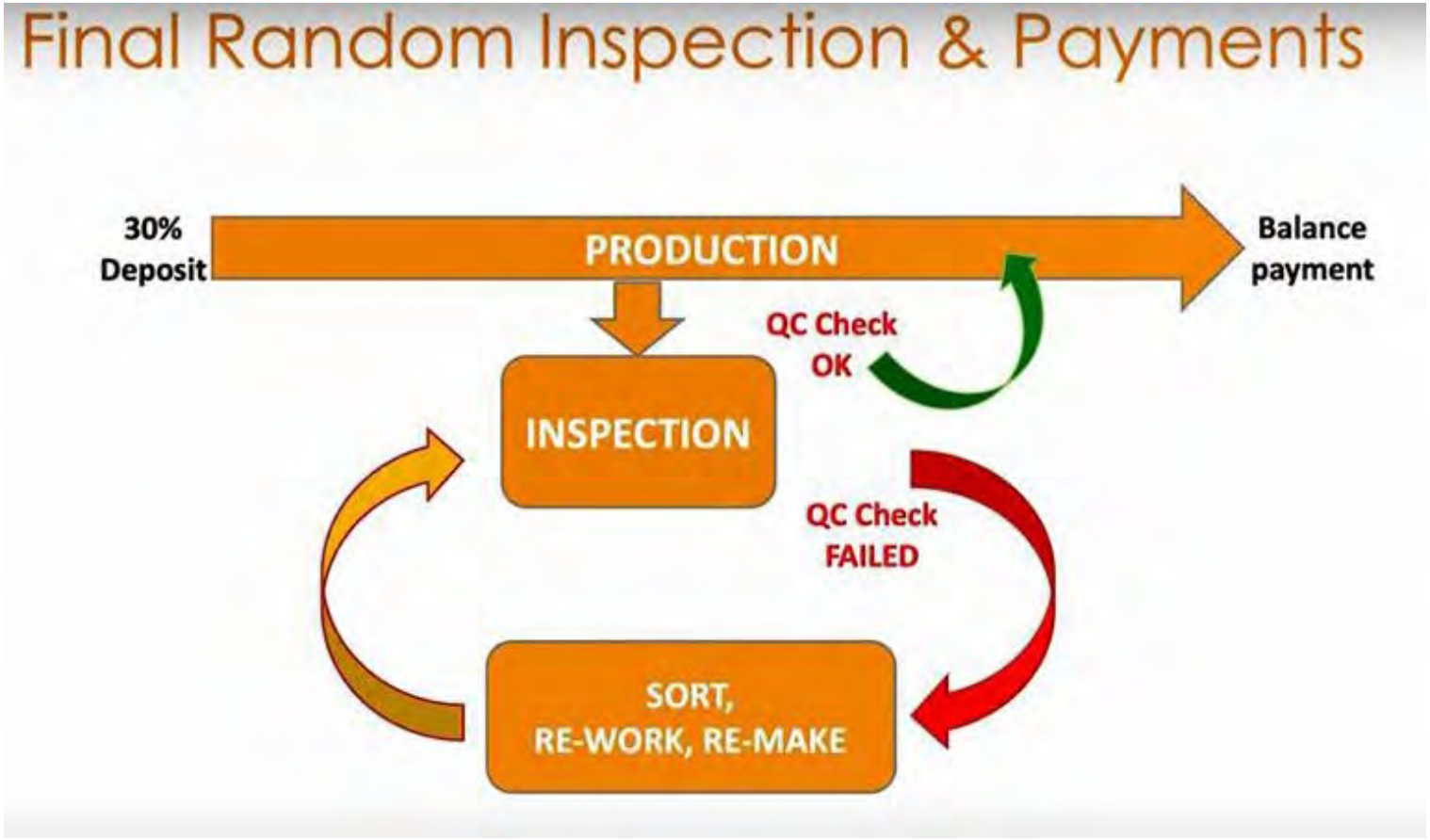
# FOB vs responsible approach

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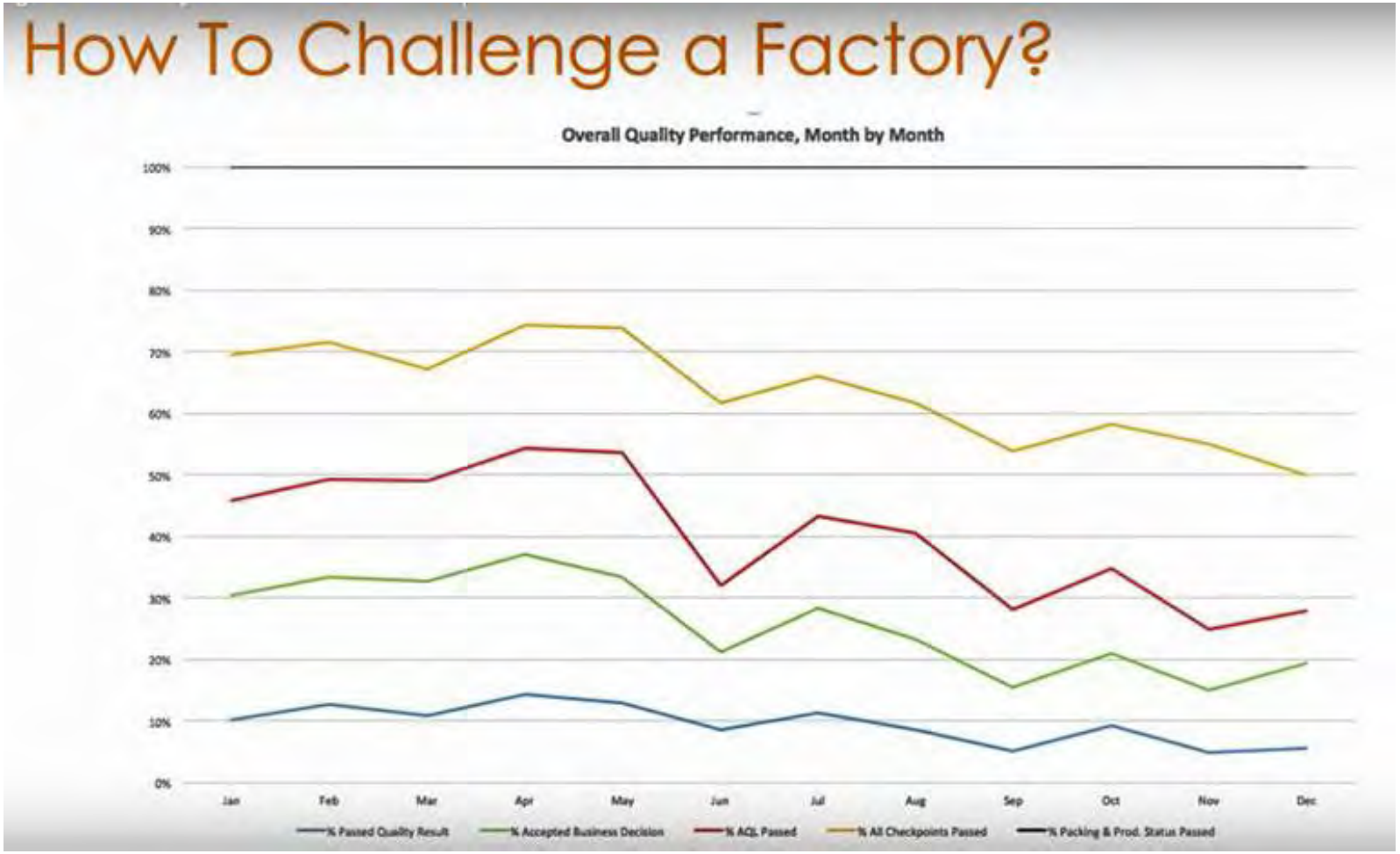
# The numbers do the talking

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# Ad hoc Sampling can not give you this


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# How can we help you?


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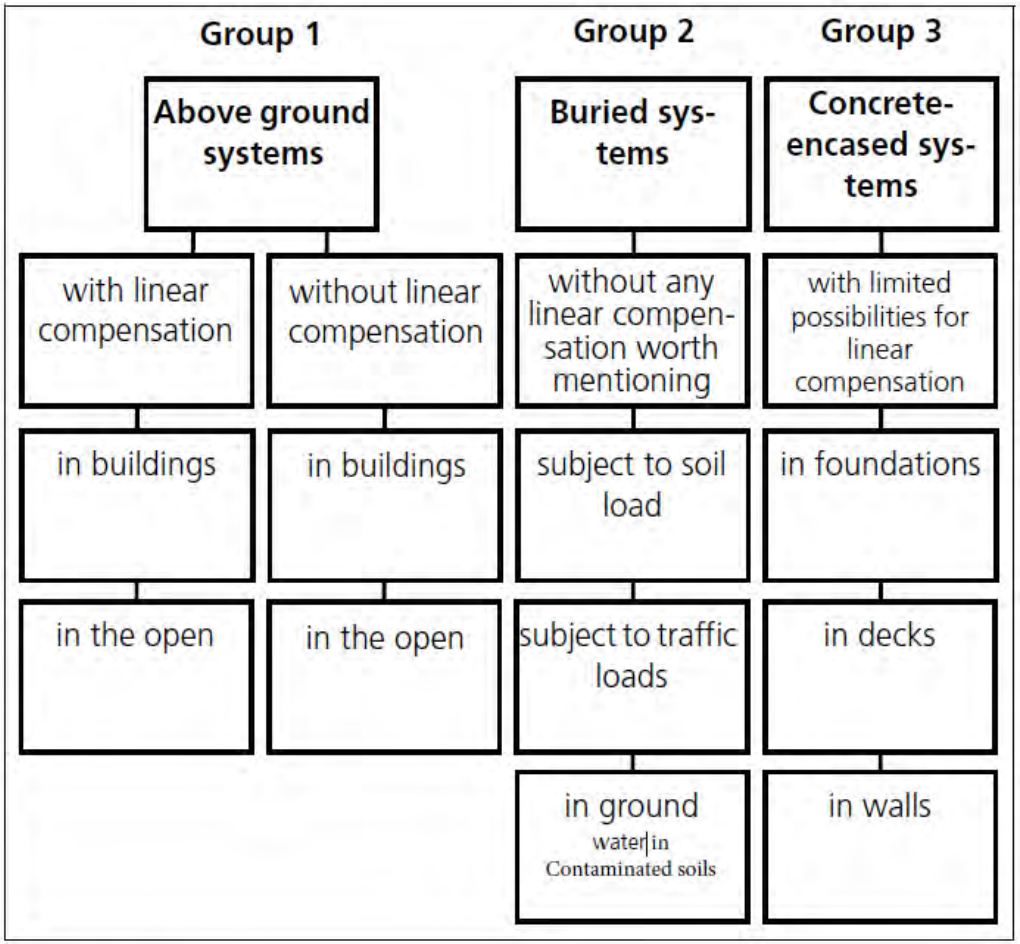
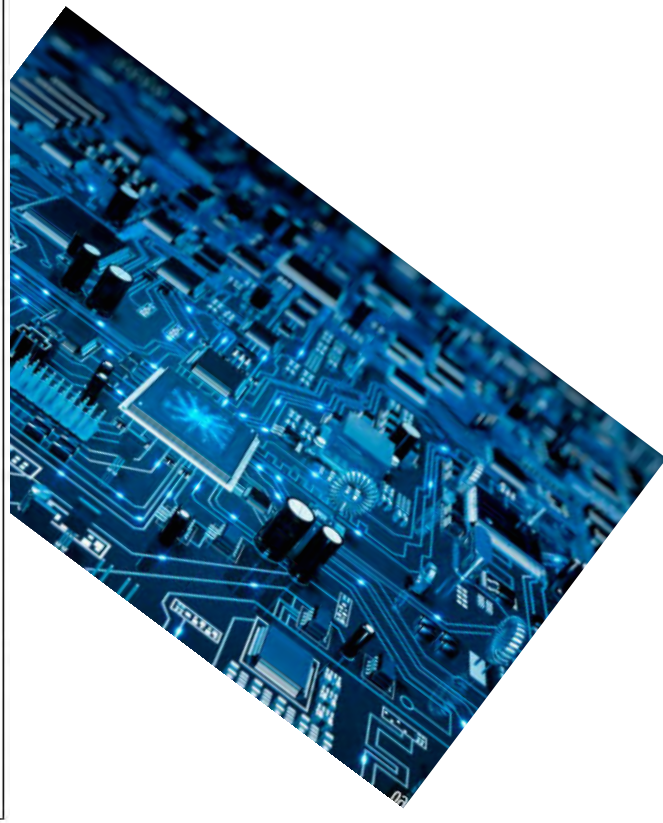
# Designing a Component for a system




*Pipe system applications*



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# Design Application

**Group 1a:**
**Above ground pipe system with linear compensation**
**In the open and in buildings**

| Hydraulic design | Pipe stress | Construction guidelines |
|---|---|---|
| Flow ratios | Chemical Resistance Permeation | Length changes |
| Pressure surges | Internal pressure | Expansion bends |
| Underpressure | Flexural stress | Compensators |
| Pressure losses | Thermal expansion Chemical Expansion | Brackets |
| | Heat stress | Fix points |
| | | Valve mounting |
| | | Protective measures |
| | | Pipe connections |
| | | Tests / quality control |

Pipe systems are usually installed so that the pipelines can elongate under the effects of heat. The latitude of movement can be provided by the installations own compensation elements (e.g. expansion bends and compensators) and by properly positioned sliding and guiding brackets. Special consideration needs to be given to ensure adherence to the acceptable support distances and the limiting of flexural loads in pipe bends and branches.

*Above ground pipe systems with linear compensation*

**Group 1b:**
**Above ground pipe system without linear compensation**
**In the open and in buildings**

| Hydraulic design | Pipe stress | Construction guidelines |
|---|---|---|
| Flow ratios | Chemical resistance Permeation | Brackets |
| Pressure surges | Internal pressure | Fix points |
| Underpressure | Heat stress | Compensators |
| Pressure losses | Flexural stress | Valve mounting |
| | Tensile and compressive stresses | Protective measures |
| | Thermal expansion Chemical Expansion | Pipe connections |
| | | Tests / quality control |

Pipe systems can also be installed without special thermal linear compensation. Pipe systems in which linear movement is impeded must pay special attention to the tensile and compressive stresses that occur, as well as to forces at fixed points. Exposed plastic pipes that are rigidly or firmly clamped (e.g. on a pipe bridge) can be exposed to large temperature variations. For this reason, calculations can be used in individual cases to test the expected stresses in order to determine if linear compensation can be excluded.

*Above ground pipe systems without linear compensation*

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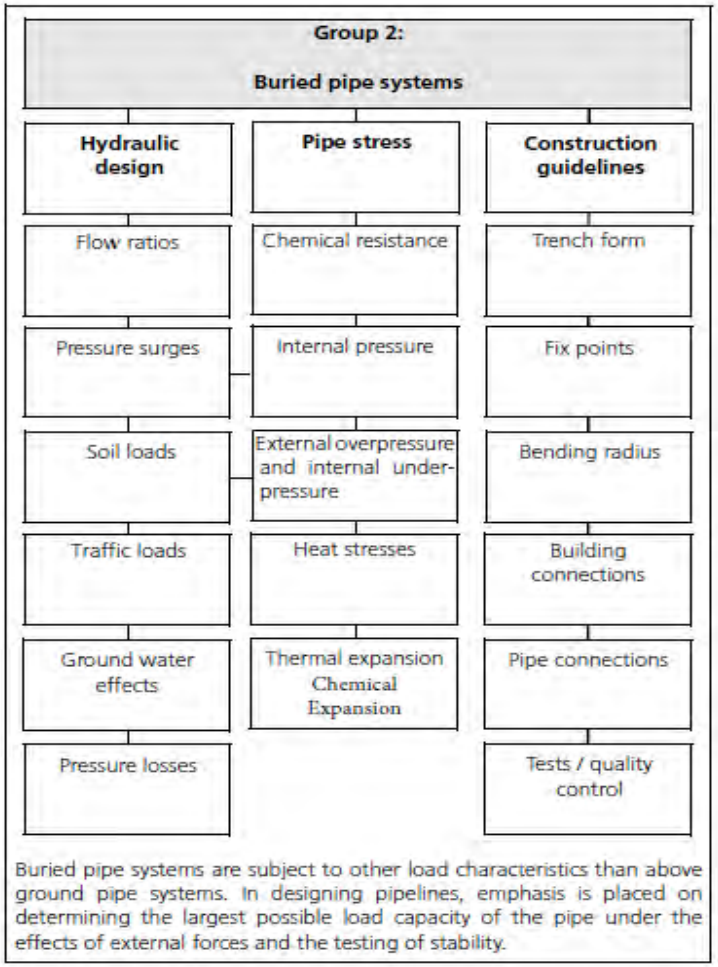
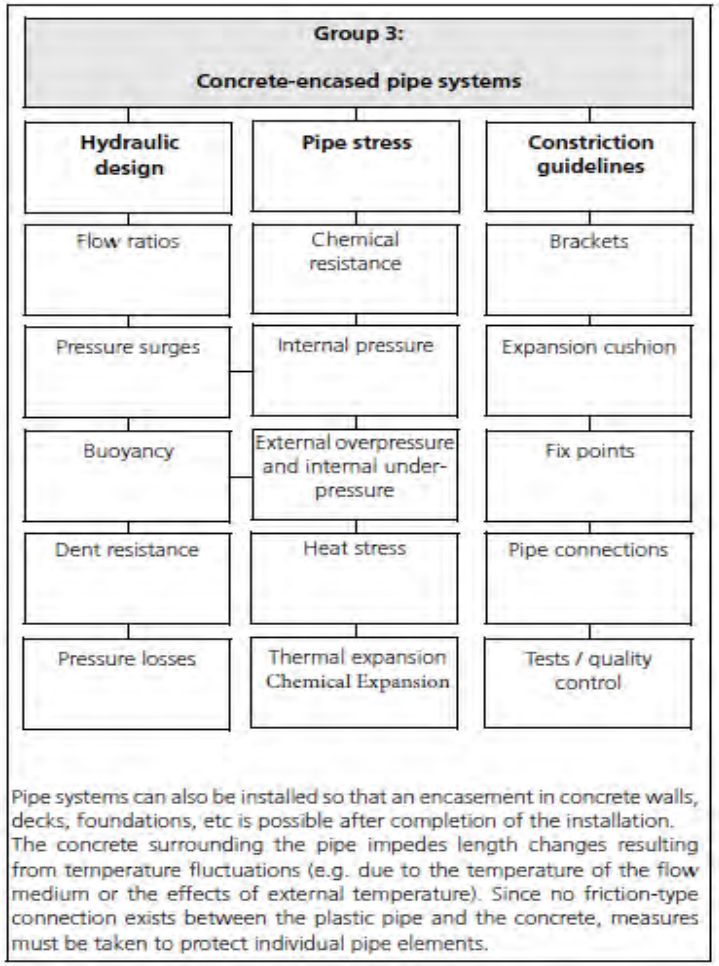
# Design Application Continue




Buried pipe systems are subject to other load characteristics than above ground pipe systems. In designing pipelines, emphasis is placed on determining the largest possible load capacity of the pipe under the effects of external forces and the testing of stability.

*Buried pipe systems*




Pipe systems can also be installed so that an encasement in concrete walls, decks, foundations, etc is possible after completion of the installation. The concrete surrounding the pipe impedes length changes resulting from temperature fluctuations (e.g. due to the temperature of the flow medium or the effects of external temperature). Since no friction-type connection exists between the plastic pipe and the concrete, measures must be taken to protect individual pipe elements.

*Concrete-encased pipe systems*

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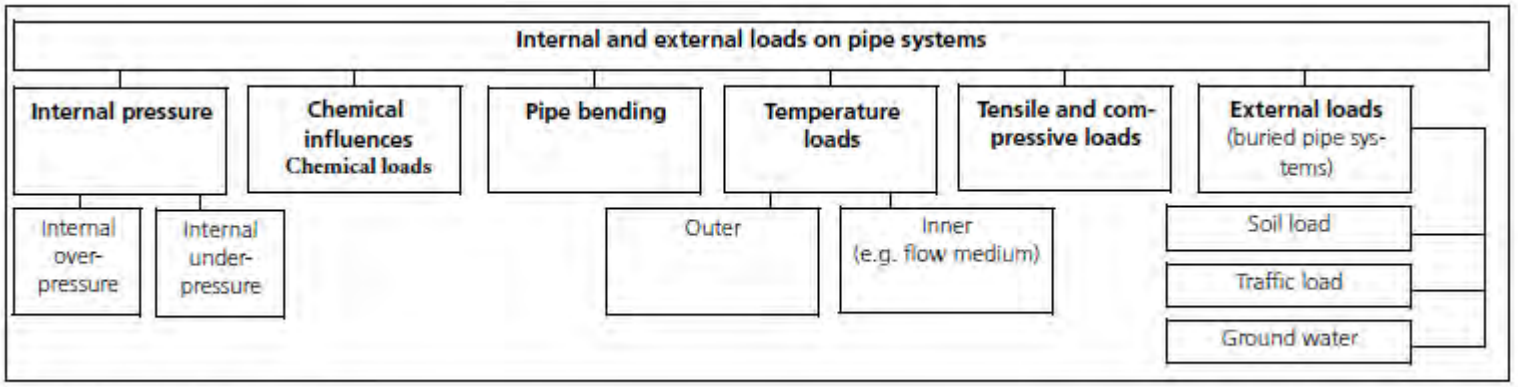
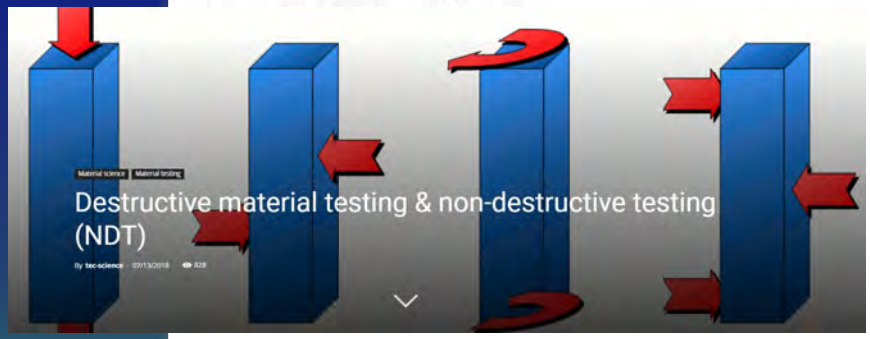
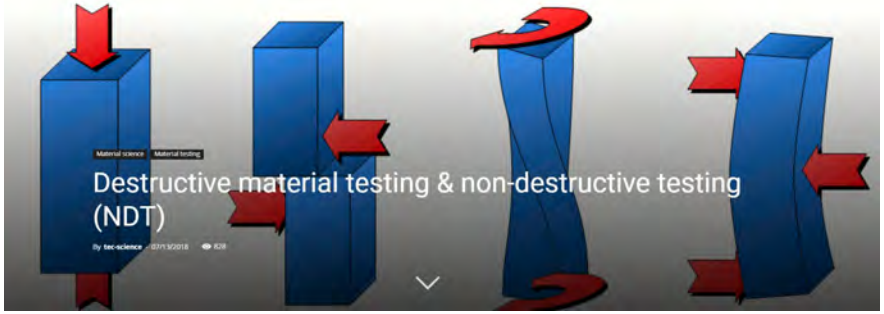
# Some loads to consider




*Internal and external loads on pipe systems*

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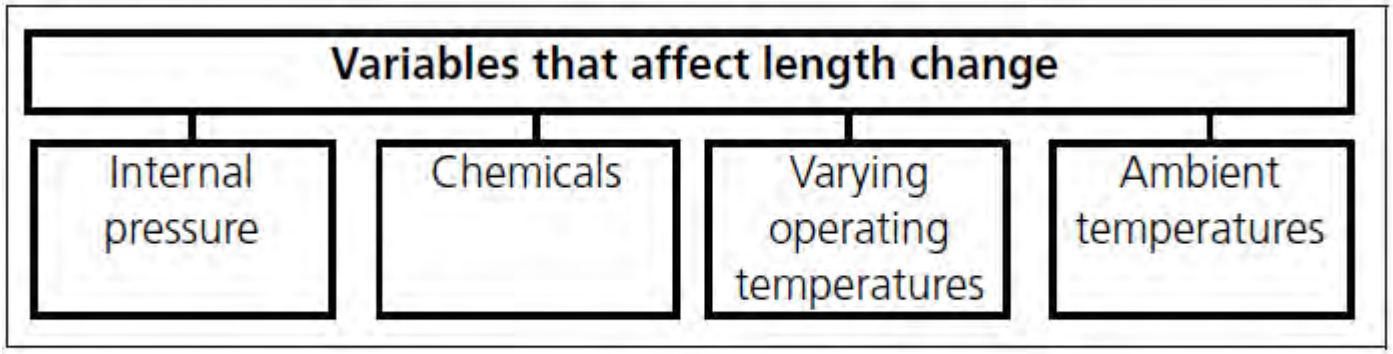
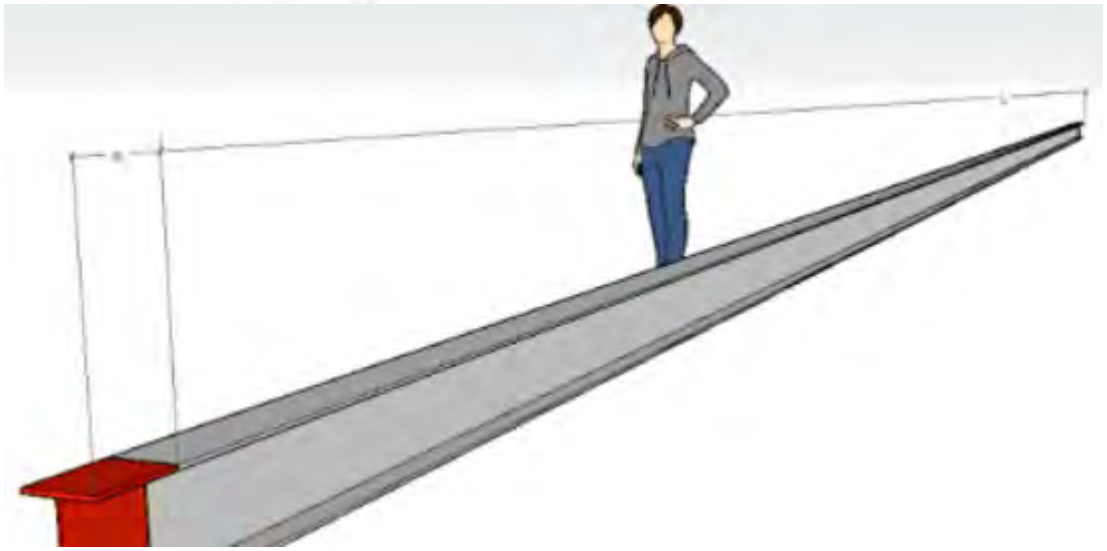
# Length Change




*Variables that affect length change*



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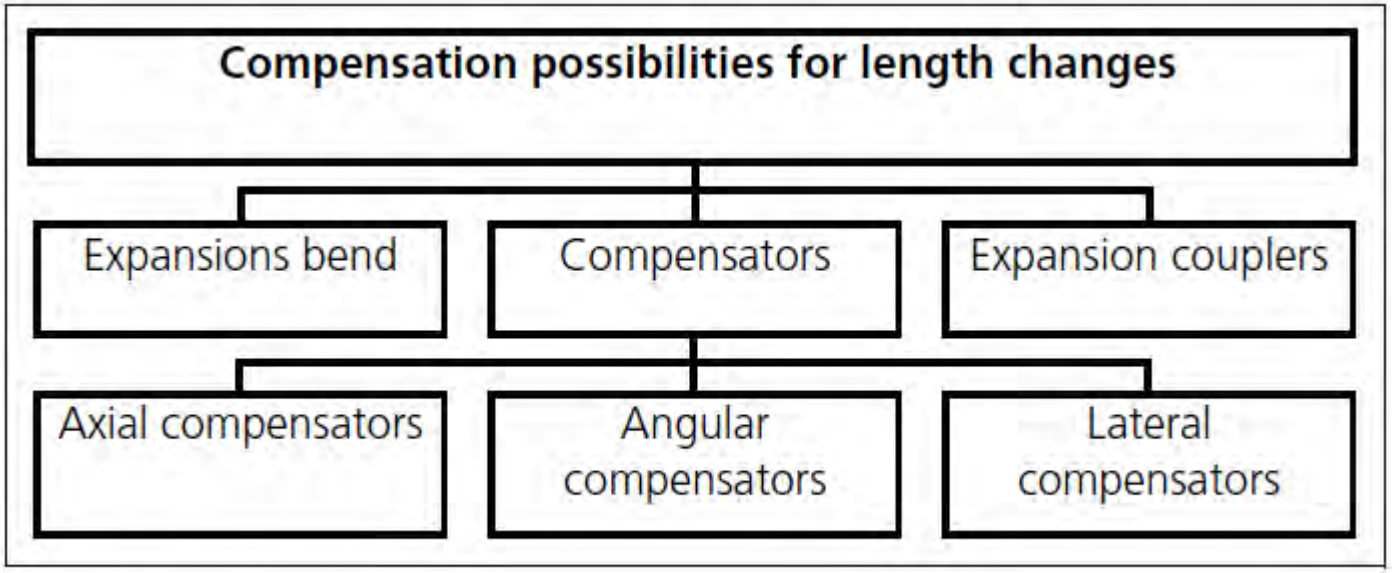
# Length Change Compensation




*Length change compensation*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# Pipe connection options

**Pipe connection options**

| Detachable connections | Non-detachable connections |
| --- | --- |
| Flange joints | Welding |
| Unions | Gluing |
| Couplings | Push-fit end trust bearing |
| Push-fit joints | |
| Expansion sockets | |
| Compression fittings | |

*Detachable and non-detachable pipe connections*

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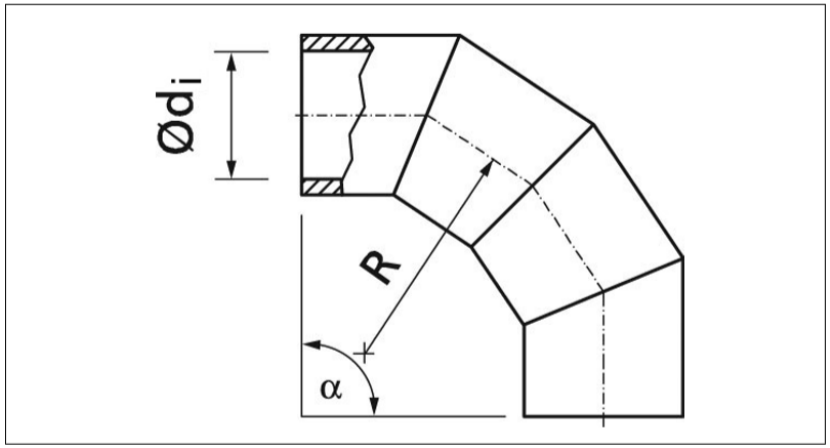
# Fitting Component

Fitting component, other than a pipe, which allows pipeline deviation, change of direction or bore. In addition, flanged socket pieces, flanged-spigot pieces and collars/couplings are defined as fittings

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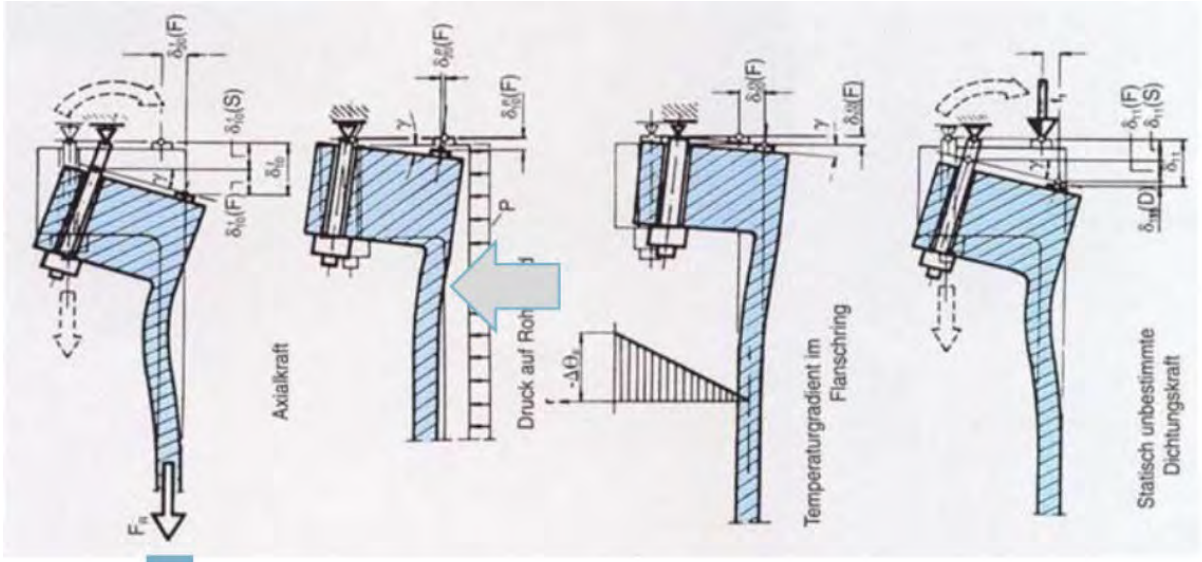
# Misunderstanding Design Specification




Internal pressure axial force

Internal pressure towards the wall

Temperature (secondary) → Total deformation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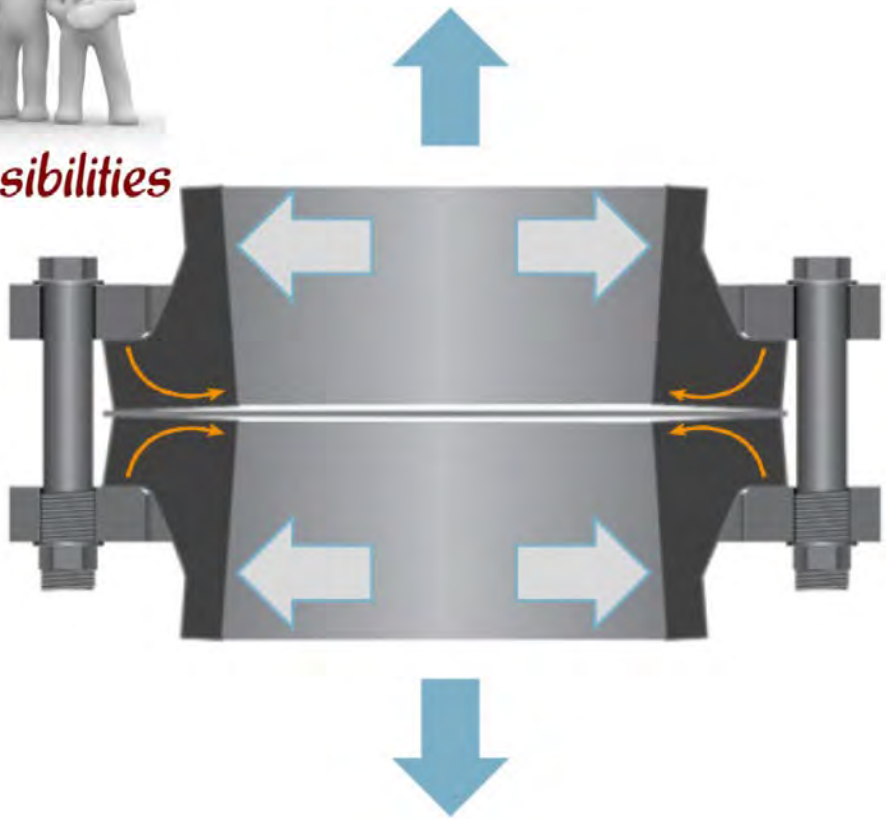
# Misunderstanding Design Specification

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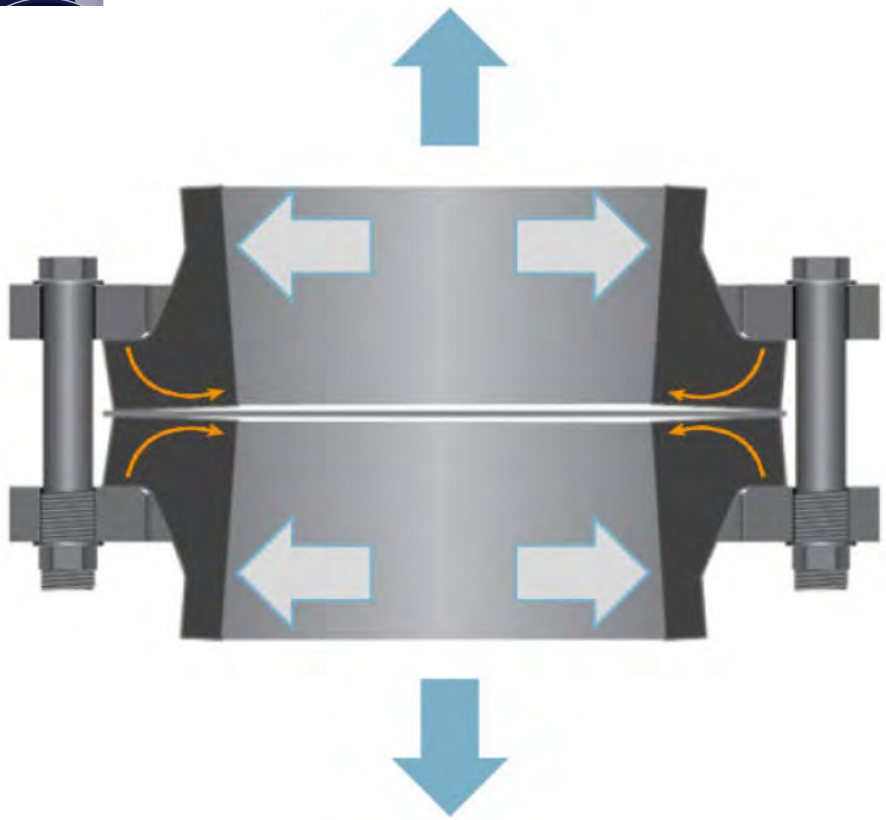
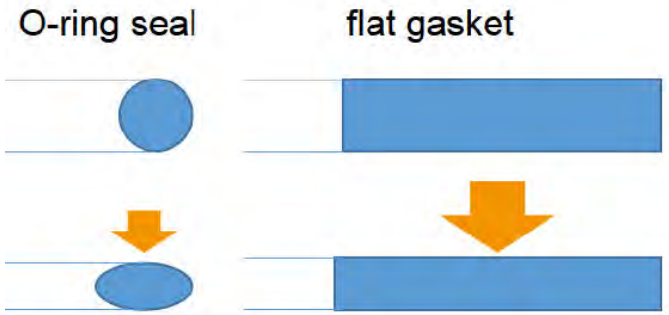
# Misunderstanding Design Specification



1 problem area - gasket

Minimum pressure of gasket 2 N/mm²
Maximum pressure of gasket 15 N/mm²




Example:
Minimum force of gasket DN 300

| | |
|---|---|
| O-ring seal | 26 kN |
| Flat gasket | 106 kN |

Maximum force of gasket DN 300

| | |
|---|---|
| O-ring seal | unlimited (KNS) |
| Flat gasket | 795 kN |

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# Characteristic design values

**Table 3. Characteristic values for the mathematical analysis in accordance with ATVDVWK-A 127 and Guideline DVS 2210-1.**

| | Characteristic values in N/mm² (MPa) for $T_B$ = 20°C | | | |
|---|---|---|---|---|
| | ATV-DVWK-A 127 | | Guideline DVS 2210-1 | |
| **Material** | $\sigma_{R(50a)}$ | $E_{R(50a)}$ | $\sigma_{V(25a)}$ | $E_{c(25a)}$ |
| PE 80 | 14 | 160 | 8.2 | 235 |
| PE 100 | 14 | 160 | 10.2 | 235 |
| PP-H | 17 | 312 | 10.4 | 330 |
| PP-B | 17 | 312 | 9.0 | 275 |
| PP-R | 14 | 200 | 10.0 | 276 |
| PVC-U | 50 | 1,500 | 25.8 | 1,600 |

**Notes on the characteristic values in Table 3:**
The characteristic values for long-term reference stress [$\sigma_{V(25a)}$] correspond to the creep curves in Guideline DVS 2205-1 and its supplements. The data for the long-term creep modulus [$E_{c(25a)}$] is taken from Guideline DVS 2205-2, Table 9.

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# Temperature and stiffness

**5.4.4.1 The effect of temperature on stiffness behaviour**

DIN 4266-1 sets out a model with reduction factors for stiffness behaviour, which can be integrated into the calculation concept of ATV-DVWK-A 127.

**Table 4. Reduction factors [$A_{3(E)}$] with reference to DIN 4266-1 for the influence of temperature on stiffness behaviour**

| Material | 20°C | 30°C | 40°C | 50°C |
|---|---|---|---|---|
| PE 80 | 1.0 | 0.85 | 0.75 | 0.60 |
| PE 100 | | 0.85 | 0.75 | 0.60 |
| PP-H | | 0.95 | 0.85 | 0.75 |
| PP-B | | 0.90 | 0.80 | 0.70 |
| PP-R | | 0.90 | 0.80 | 0.70 |
| PVC-U | | 0.90 | 0.75 | 0.55 |

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# Reduction factors for strength in relation to temperature

**Table 5. Reduction factors [$A_{3(\sigma)}$] for the influence of temperature on strength behaviour**

| Material | 20°C | 30°C | 40°C | 50°C |
|---|---|---|---|---|
| PE 80 | 1.0 | 0.85 | 0.73 | 0.40 |
| PE 100 | | 0.85 | 0.73 | 0.63 |
| PP-H | | 0.85 | 0.71 | 0.58 |
| PP-B | | 0.83 | 0.69 | 0.56 |
| PP-R | | 0.85 | 0.71 | 0.60 |
| PVC-U | | 0.80 | 0.60 | 0.41 |

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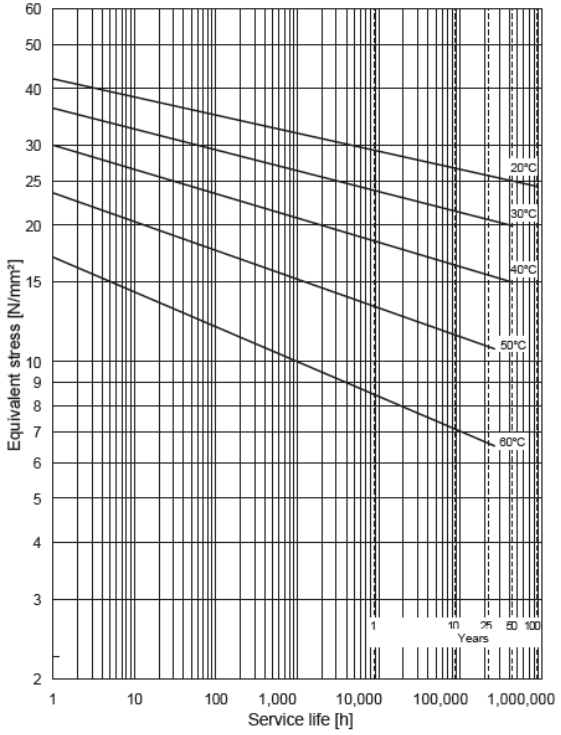
# Design graphs

1 PVC-NI, polyvinyl chloride, normal impact strength

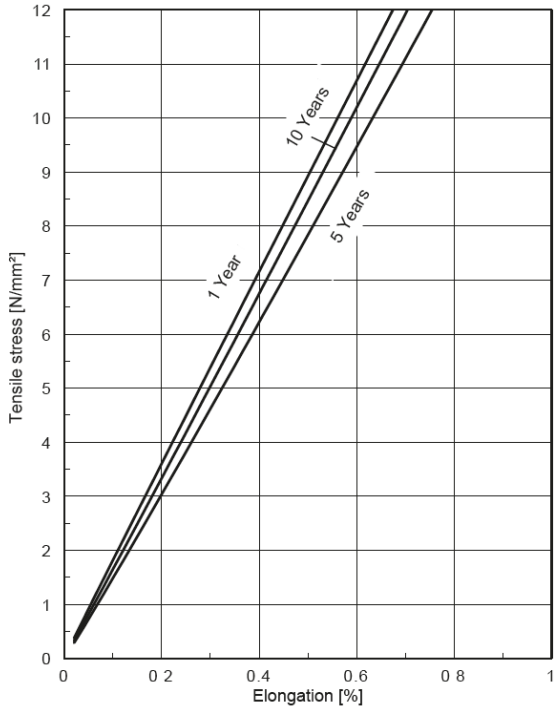
1.1 Creep curves for pipes




Straight line equation:
$\log(t) = A + B/T \times \log(\sigma) + C/T + D \times \log(\sigma)$

Coefficients of the minimum curves:
A = -164,647
B = -29,378.37
C = 60,161.4
D = 75,2053

1.2 Isochronous stress/strain diagram for 20°C

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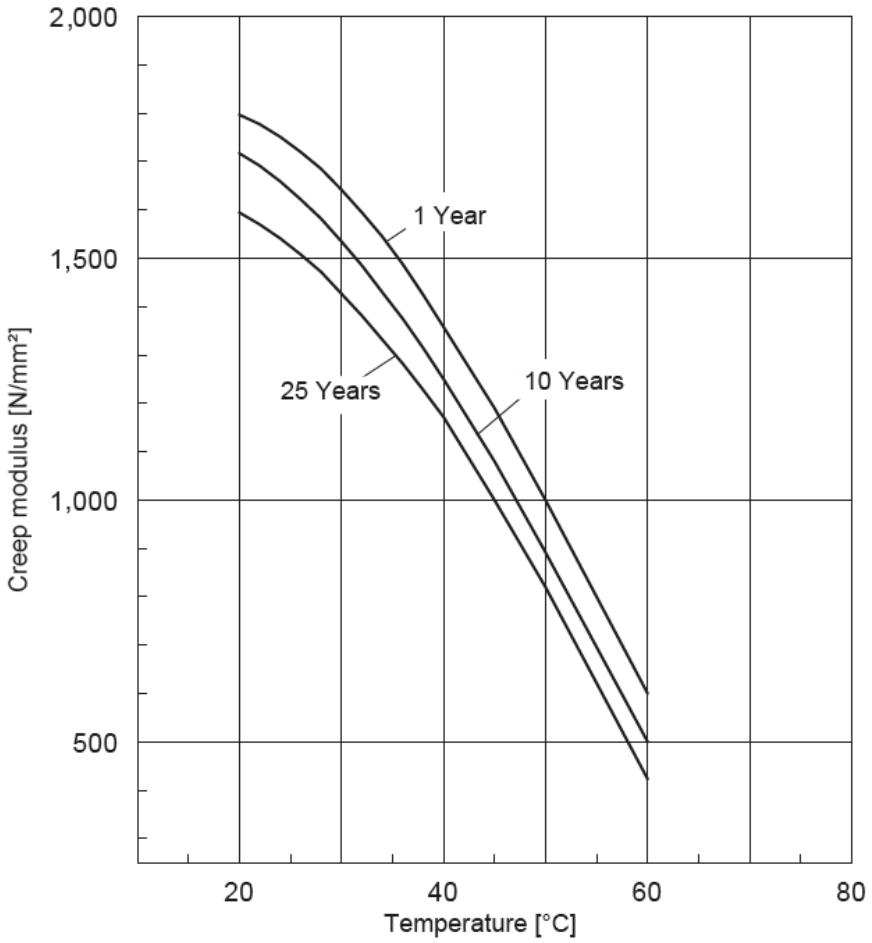
# Design Graphs Continue

**1.3 Creep modulus curves for one, ten and 25 years for the stress range from 2.5 N/mm² to 10 N/mm²**

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# Reduction Coefficients

**3 Reduction coefficients $A_1$ for moulding materials made of PVC**

1. Material description

The four groups correspond to the information in ISO 11833-1.

| Moulding material or semi-finished product | PVC-NI | | | PVC-RI | | |
|---|---|---|---|---|---|---|
| | Plates | | Pipes | Plates | | Pipes |
| | Extruded | Pressed | | Extruded | Pressed | |
| Notched impact strength [kJ/m²] at 23°C | > 2 | > 3 | | > 5 | > 10 | |
| Vicat softening temperature [°C] | ≥ 75 | ≥ 78 | | ≥ 72 | ≥ 75 | |
| Modulus in tension [N/mm²] at 23°C | ≥ 3,000 | ≥ 3,000 | | ≥ 2,500 | ≥ 2,500 | |
| Creep strength, according to | ISO 11833-1[1)] | ISO 11833-1[1)] | Section 1.1 | ISO 11833-1[1)] | ISO 11833-1[1)] | Section 1.1 |

[1)] Creep curves are not available. Therefore, ISO 11833-1 is used.

Testing standards:

Notched impact strength: ISO 179-1/1eA (Charpy)
Vicat softening temperature: DIN EN ISO 306, procedure. B 50
Modulus in tension: ISO 527-2
Creep strength: ISO 1167-1

2. Reduction coefficients $A_1$

| Semi-finished product | Material designation | Notched impact strength kJ/m² | Temperature [°C] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | -10 | 0 | 10 | 20[2)] | 40 | 50 | 60 |
| Plates, extruded | PVC-NI | < 2 | 1.8 | 1.8 | 1.8 | 1.8 | 1.6 | 1.6 | 1.5 |
| Plates, pressed | | < 3 | 1.7 | 1.7 | 1.7 | 1.6 | 1.4 | 1.3 | 1.2 |
| Pipes | | | | | | | | | |
| Plates, extruded | PVC-RI | < 5 | 1.7 | 1.6 | 1.5 | 1.4 | 1.2 | 1.0 | 1.0 |
| Plates, pressed | | < 10 | 1.5 | 1.3 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 |
| Pipes | | | | | | | | | |

[2)] This value also applies to the normal temperature of 23°C.

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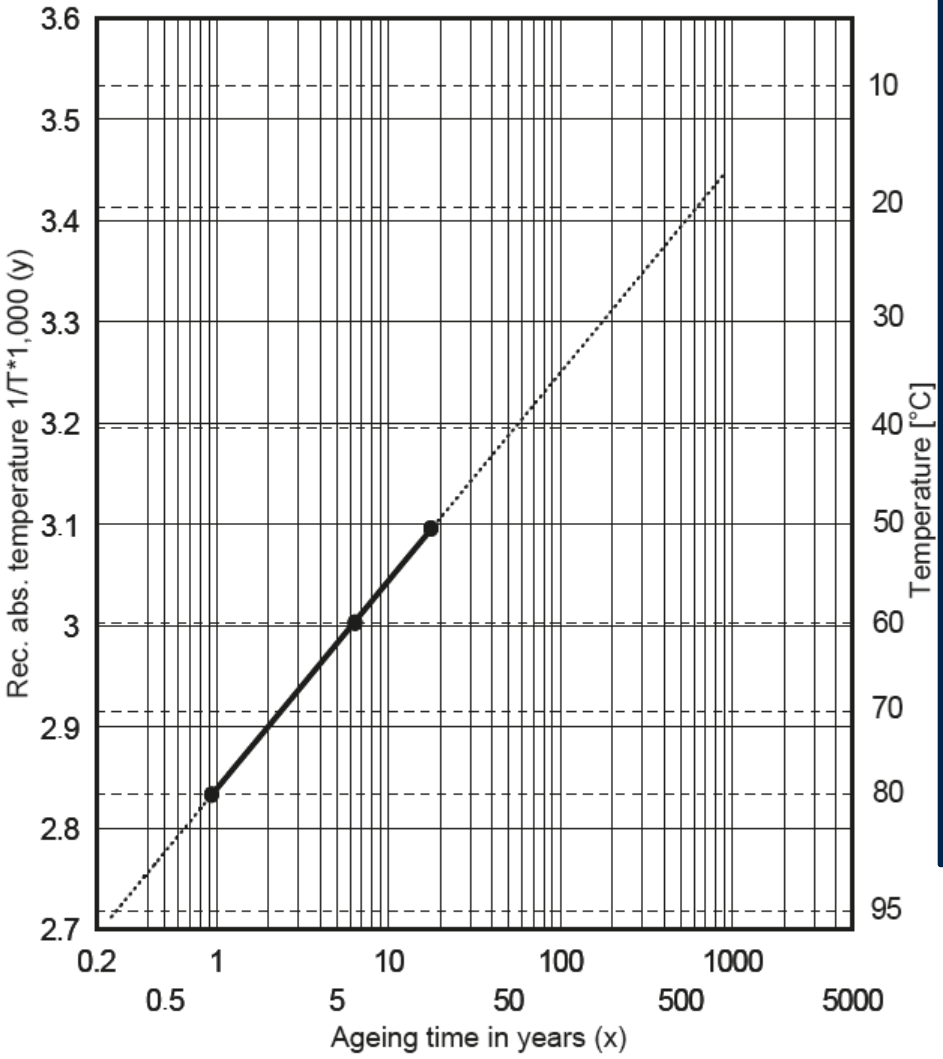
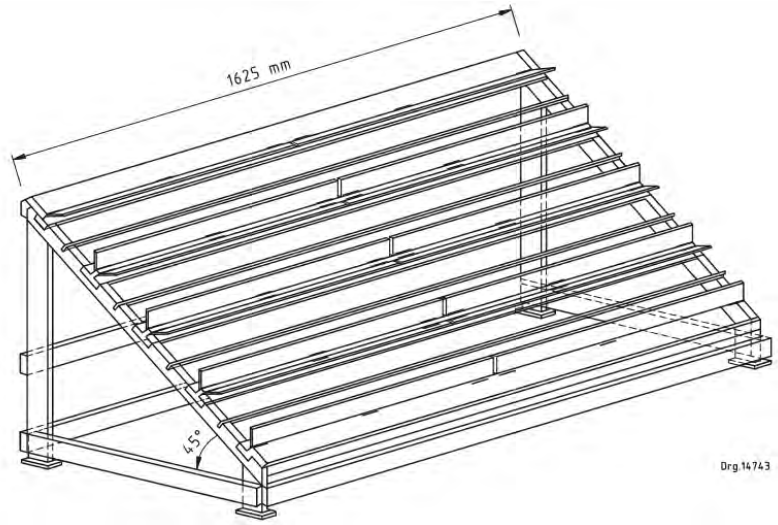
# Heat Aging

**5 Heat ageing limit in the case of PE**




**SANS 966-2:2013**
Edition 1.7

**8.15.4 Procedure**

Using the micrometer, determine the point of thinnest wall section on the circumference of each specimen. Draw a line (or, in the case of specimens of nominal size exceeding 140 mm, paint a band of width 6 mm) down the full length of the specimen to indicate this thinnest section. From figure 7, calculate the exposure period necessary to expose the specimens to 3,9 GJ/m$^2$ of solar radiation.

Arrange the specimens on the stand with the lines facing outward. Expose the specimens for the calculated period and, at the end of that period, remove the specimens from the stand and test them at 20 °C in accordance with 8.12, but deliver only one impact and ensure that the impact is delivered centrally on the previously marked (exposed) surface of each specimen.

Check for compliance with 5.12.

Function
of the straight lines:
$y = a + b * (\ln x)$
$a = 2.83835$
$b = 0.08939$

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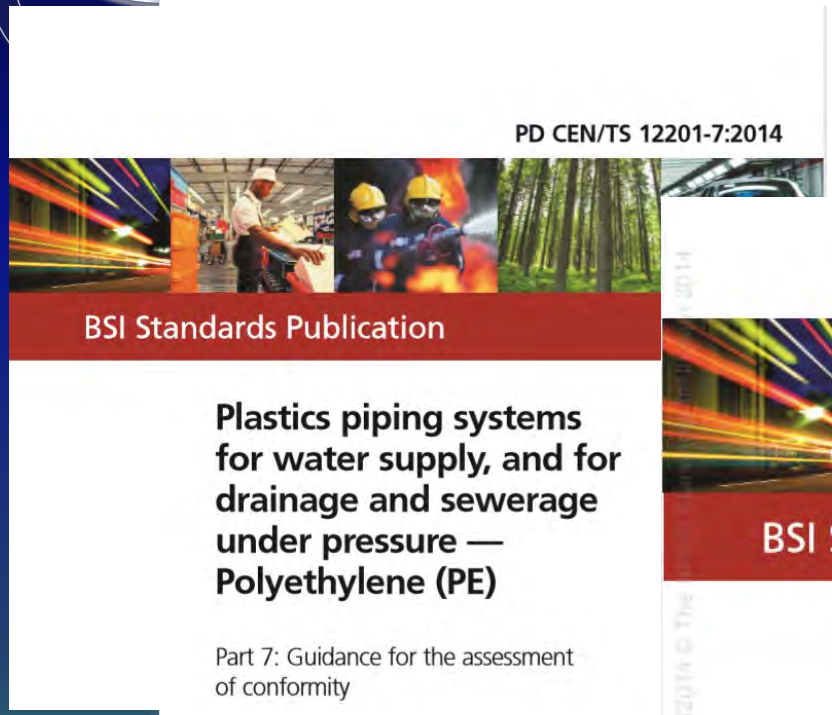
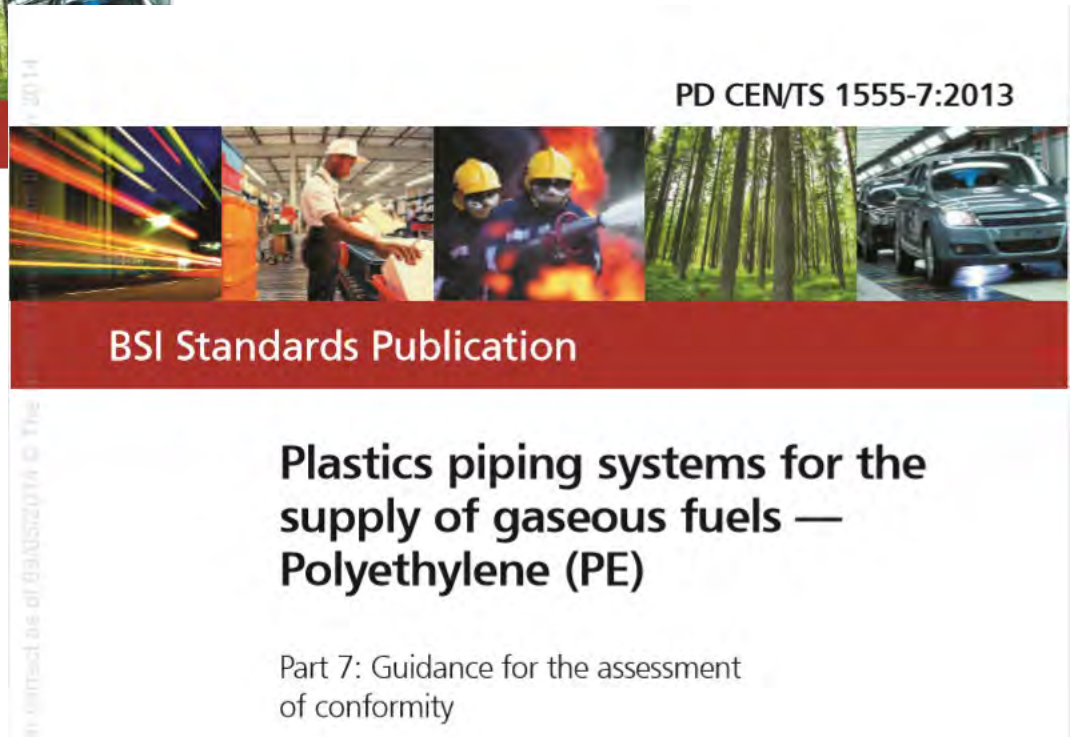
# Guidance for Assessment

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# HDPE /PVC/PP Pipe and Components

## Introduction

Figure 1 and Figure 2 are intended to provide general information on the concept of testing and organization of those tests used for the purpose of the assessment of conformity. For each type of test, i.e. type testing (TT), batch release test (BRT), process verification test (PVT), and audit test (AT), this part of EN 12201 details the applicable characteristics to be assessed as well as the frequency and sampling of testing.

A typical scheme for the assessment of conformity of compounds, pipes, fittings, valves, joints or assemblies by manufacturers is given in Figure 1.

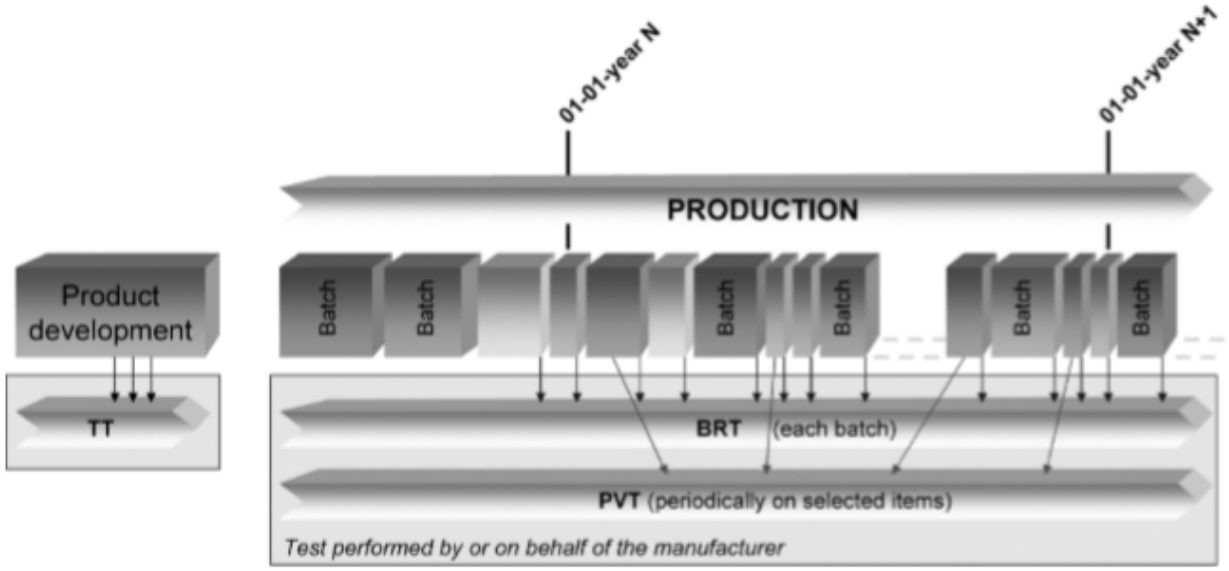


**Figure 1 — Typical scheme for the assessment of conformity by a manufacturer**

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# Quality Plans for Assessment of Conformancy

A typical scheme for the assessment of conformity of compounds, pipes, fittings, valves, joints or assemblies

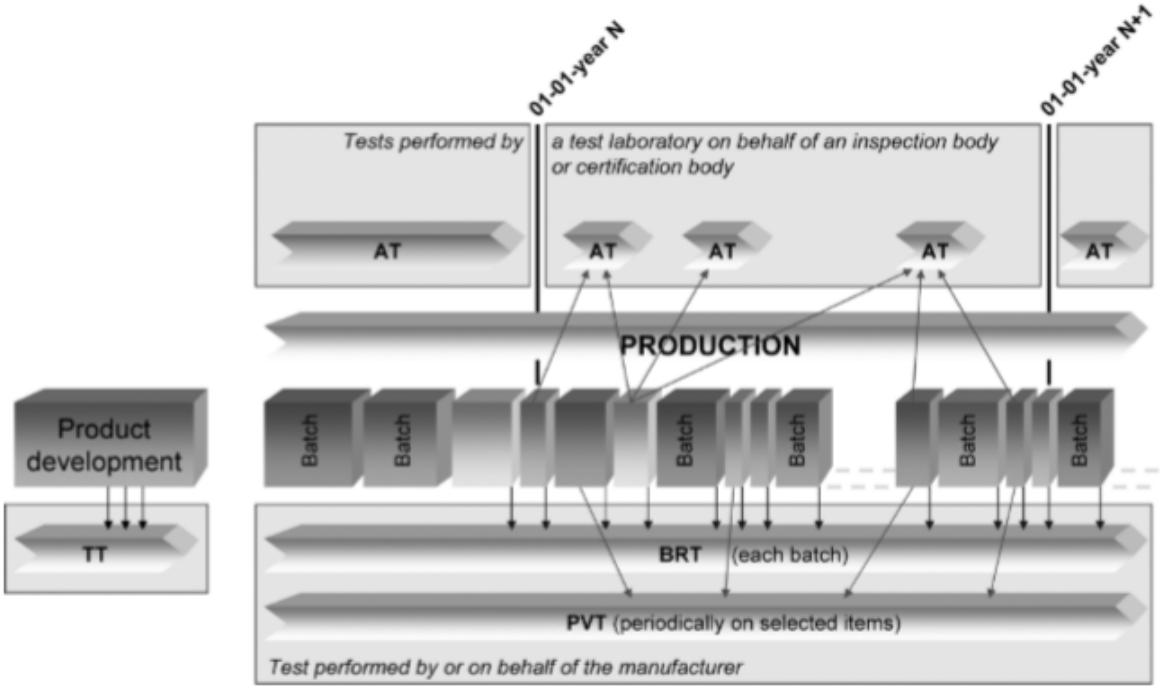


**Figure 2 — Typical scheme for the assessment of conformity by a manufacturer, including certification**

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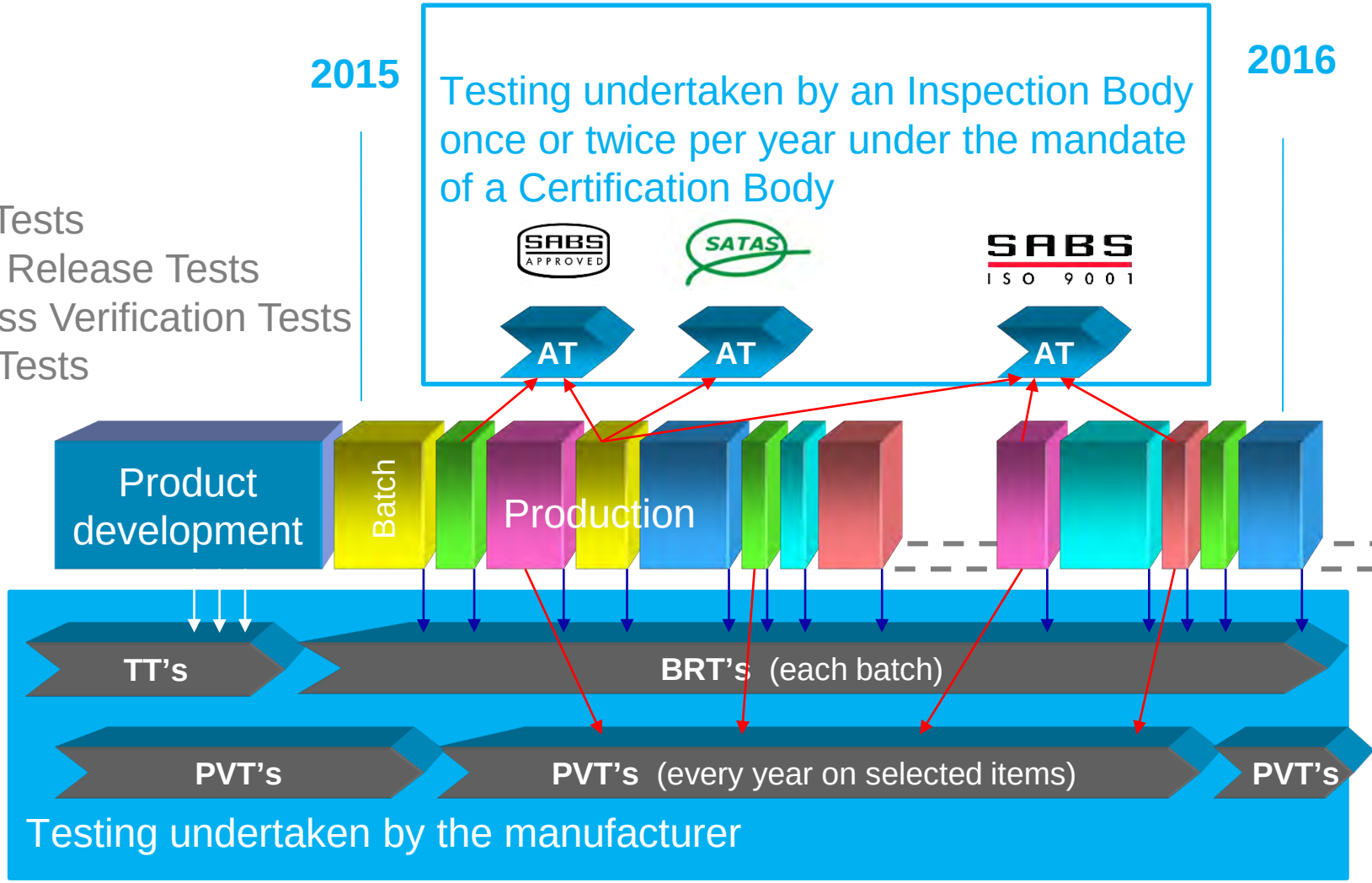
# Diagram representing a typical quality plan for a pipe or fitting manufacturer

TT: Type Tests
BRT: Batch Release Tests
PVT: Process Verification Tests
AT: Audit Tests

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# The key elements of a sustainable quality management system

- Simplify and minimize the number of procedures as far as practical whilst complying with standards and ensuring quality
- Only employ procedures and systems that add value to the process and keep them as simple as is practical
- Encourage the use of industry organizations that promote consistently high-quality products through 3rd party testing, such as the PE100+ Association/ SAVA / SAPPMA / IFPA / JASWIC
- Encourage the use of conformity assessment schemes and quality marks as these provide a simple and quick means for end users to determine whether a pipe or fitting complies with relevant standards – eg. PE100+ Association/ SAVA / SAPPMA / IFPA / JASWIC
- Encourage continuity between the quality systems of different stakeholders by referring to common standards and procedures **(Procurement Process**)– avoid the weakest link !

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# Certification Schemes

- Let us look at a variety of certification schemes that exists;

- Accredited VS Non-Accredited
- Regulated VS Non-Regulated
- Compulsory VS Non-Compulsory
- National, Regional, International

- Schemes that allow or mandate the use of a product certification mark and others don't.

- Compulsory certification does not have to be entirely handled by government authorities. Certification can be issued on the basis of reports from accredited private laboratories.

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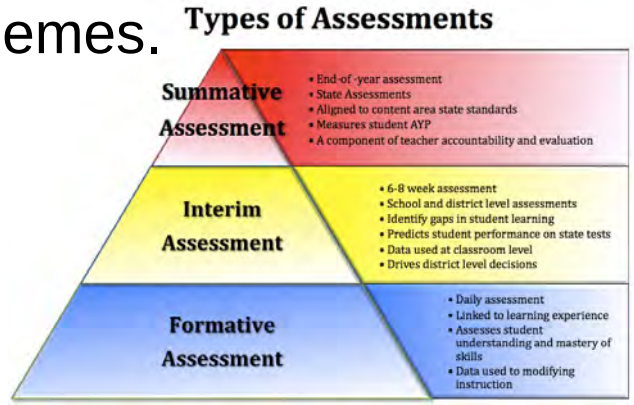
# Guidance standards for Conformancy assessment

- Fortunately there is some guidance out there: ISO/IEC 10765 and 10767

- ISO/IEC 17065; Conformity assessment – Requirements for bodies certifying products, processes and services

- ISO/IEC 10767; Conformity assessment- Fundamentals of product certification and guidelines for product certification schemes.

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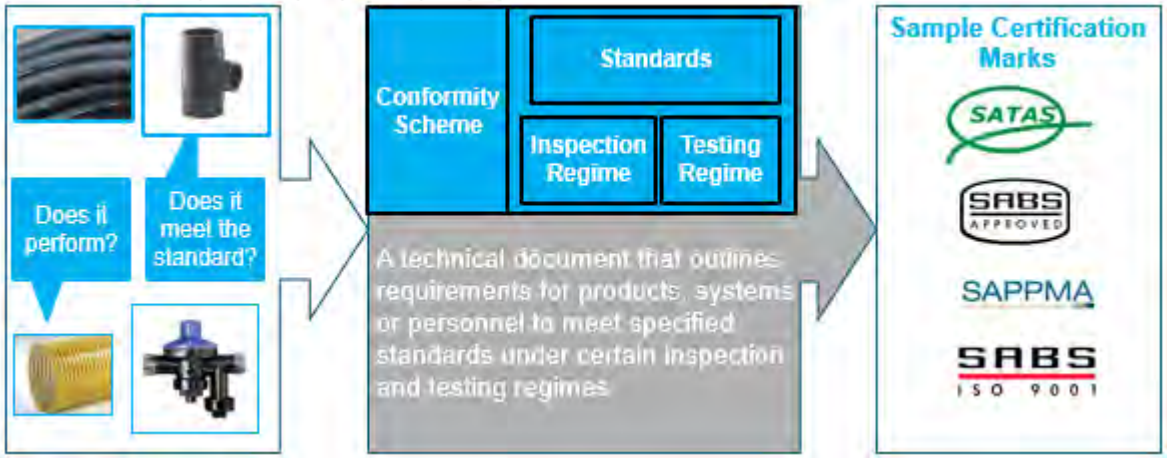
# Dimension of Quality (Conformance)

- **Conformance**: Conformance is the precision with which the product or service meets the specified standards.



# The Elements of Conformity assessment need to be understood.

**Definition of conformity assessment**: Conformity Assessment is defined in ISO/IEC 17000 as;
The demonstration that specified requirements relating to a product, process, system, person or body are fulfilled.

**i.e. does the product fulfil these requirements**

***Conformity Assessment is not the evaluation of the quality of a product, process or system***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# The Elements of Conformity assessment need to be understood.

**Definition of conformity inspection:** Inspection is defined in ISO/IEC 17000 as; The examination of a product design, product, service, process or plant/installation, and determination of the conformity with specific requirements or, on the basis of professional judgement, general requirements.

**The results of inspection may be used to support certification**

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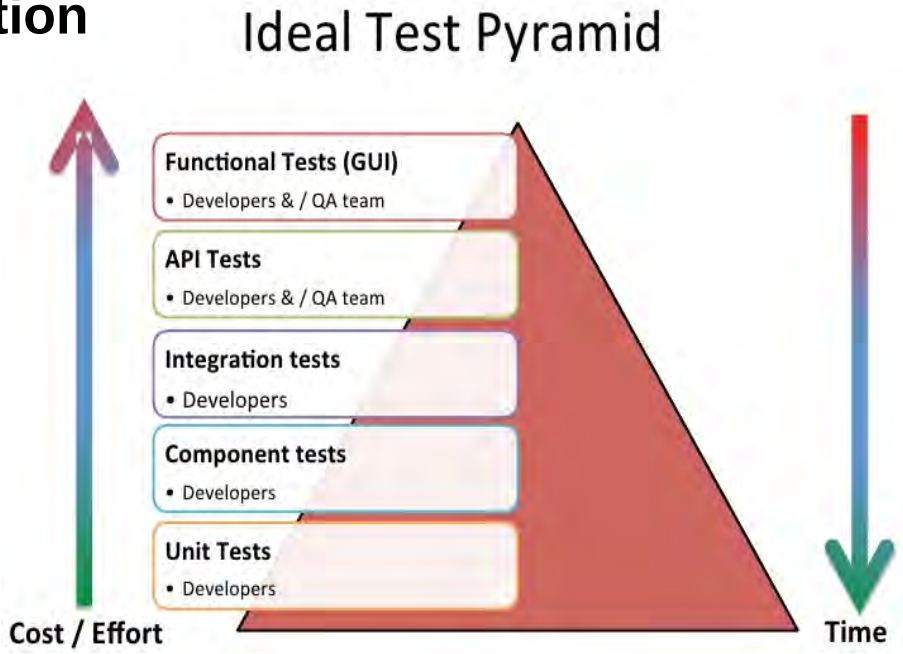
# The Elements of Conformity assessment need to be understood.

**Definition of testing:** Testing as defined in ISO/IEC 17000;

**Testing:** Determination of one or more characteristic s of an object of conformity assessment according to a procedure

**Procedure:** Specified way to carry out an activity or a process

**The results of inspection may be used to support certification**

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# The Elements of Conformity assessment need to be understood.

**The definition of certification:** Certification as defined in ISO/IEC 17000;

**Certification:** Third-party attestation related to products, processes, systems or persons

***A certificate is not a test report***

**Attestation:** The issue of a statement by an organization that they have undertaken review(assessment) to verify that a product etc. has demonstrated compliance (conformity) with particular requirements set out in the conformancy scheme documents and related standards etc.


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# NB: Understand your Conformance objectives


- Have realistic objectives- How much testing do we want to do on a regular basis, what is practice and affordable?

- Remember certification bodies do not automatically understand or know your specific system needs, and will from a content point of view only have the minimum required assessment fundamentals to be able to be certified as a certification body.

- It will be important that you familiarize yourself with the assessment fundamentals of your suppliers certification bodies to ensure that the criteria of importance to your system as a minimum is covered.

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# Product Quality


- As it is now quite clear that certification does not deal with product or service quality, it will be of importance to focus more attention on control systems for product and services.

- Over and above the above stated information, it will be of importance to understand if the manufacturers PQP Product Quality Plans are in line with sound quality principles and standards and to ensure that they are included per product standard in the Quality Management system SANS ISO 9001 of each manufacturer or supplier of goods or services.

- Each manufacturer supplier of goods needs to have a $QCP_{(Manufacturer)}$ Quality Control Plan in line with its capabilities to ensure that compliant products are shipped and supplied.

- All recipients of products and services need to have in place a
- $QCP_{(Purchaser)}$ Quality Control Plan aligned with the capabilities of its suppliers of product and services to ensure compliance to specification.

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# Conformity assessment VS Conformity Control

- Conformity assessment. Any activity concerned with determining directly or indirectly that relevant requirements are fulfilled (ISO/IEC Guide 2).
- Conformity control. Ensuring that products remain conforming once they have been certified as conforming.

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# Resources needed to determine conformity

- The resources needed to determine conformity might be considerable; gauges, test equipment, specialist skills and knowledge and therefore rather than equip every worker with the means to determine conformity, the task is managed by a separate group of dedicated specialists. In effect these specialists support the worker and allow the worker to make the judgement on acceptability. But when this judgement remains with the specialists it again removes the worker's right to self-control.

# Elements for Managing System/Product Performance

As with other materials, the life is ***dependent on manufacture, transport, handling, installation, operation, protection from third party damage and other external factors.***

Provided that pipeline system components are ***appraised and supplied to nominated industry standards under third-party product certification systems, and provided pipelines are designed and constructed correctly, then the likelihood of failure is minimized.***

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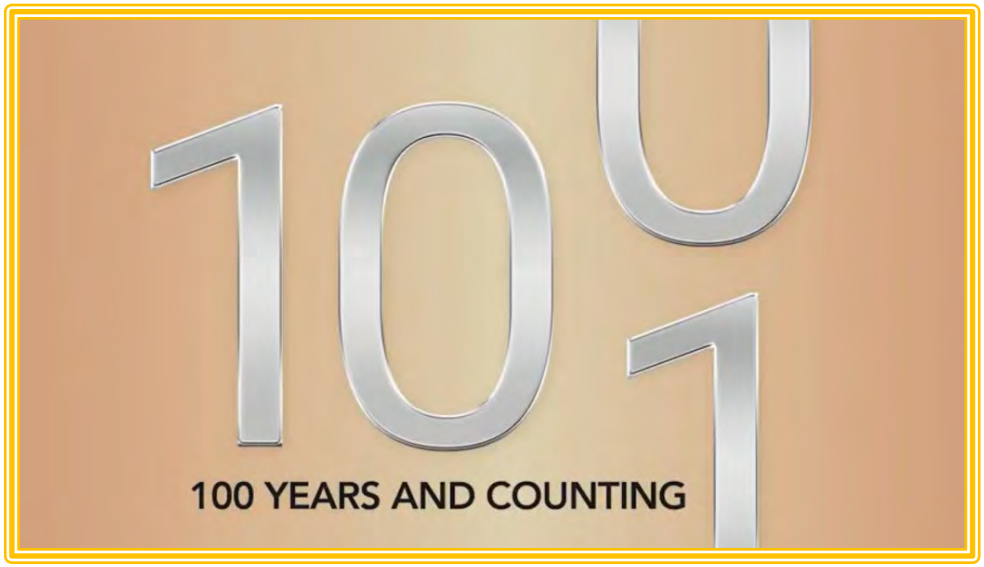
# How long will it last?

For correctly manufactured and installed systems, the actual life cannot be predicted, but can logically be expected to be well in excess of 100 years before major rehabilitation is required.

If a system life is to be assigned beyond 100 years, it has to be based on the likelihood of failure arising from the above factors, not the pipe regression curve. Pipe strength has been shown not to decrease with time-in fact, it increases slightly. "Instantaneous " burst pressure after a period in service will be at least equal to that of new pipe.




# Questions and Answers