



Brief Overview of SIGMA Quality Plan (SQP)

BRIEF OVERVIEW OF THE SIGMA QUALITY PLAN

The **SIGMA Quality Plan** is unique in the industry. We realize we have a special responsibility as all our products are made overseas and we have designed our Quality Plan to assure reliability to “3 Sigma” level. The plan starts with each casting having a cast ID that we call “heat number” that enables us to identify the location, foundry #, date, and batch of production. The plan rests on five elements:

- i) Preparation and implementation of Quality Inspection Procedures (QIP) for every product line.
- ii) Audit, inspection and testing of the product at the manufacturing location by Sigma engineers stationed in the factories, prior to shipping.
- iii) Qualification data on physical, chemical and microstructure tests submitted by the foundry through Material Test Reports (MTR);
- iv) Verification of that data by Incoming Quality Control (IQC) procedures at our facilities in USA;
- v) Control of process through feedback obtained from statistical analysis including Statistical Process Control (SPC) of critical factors

SIGMA has produced detailed Quality Inspection Procedures (QIP) for each product category to guide our overseas foundries. These QIP incorporate the relevant AWWA standards and go much further in detail as to what SIGMA expects the foundry to do.

The trinity of the QIP, the Quality Plan and the SPC together assure us and you – our customer of the high reliability of SIGMA products (eg., Pipe Fittings, Joint Restraints, MCC).

Quality Control in the Foundries

All our foundries follow Sigma’s Quality Inspection Procedure at every stage of production. Explained below briefly are some controls exercised to ensure that the customer is provided with consistent top quality products.

All our foundries are ISO approved.

The Audit of the ISO systems at the foundries is carried out periodically by Sigma Engineers. Sigma overseas technical office is audited by UL on an annual basis for compliance of the above.



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Periodically customers like New York City would send their own consulting engineers like Moody, BVQ to these selected Sigma locations for audit of the foundry Quality Procedures. Sigma would welcome any audit of the procedures at the foundry either directly by the customer and/or any third party inspection agency nominated by the customer.

MATERIAL:

Metal:

During the process of melting the foundry ensures that the chemical analysis is carried out for each and every melting batch when melted in an electric melting furnace and a minimum of once every three hours in a continuously operating Cupola furnace. The chemical readings are recorded on the MTR (Material Testing Report) format. A Carbon Equivalent Value (CE Value) is measured for the metal in the furnace. The temperature of the liquid metal is measured prior to pouring into molds.

For Ductile Iron sample of the last metal poured for every ladle is taken for micro structure analysis to ensure that there has been no fading. The castings poured from this ladle are taken for further processing only after the batch is approved for microstructure. The micro readings are entered into the MTR report. There is a further check built into our system. All critical castings have an integral cast stub that can be broken off to examine the micro structure on the actual casting.

Test Bars are poured at the end of each ladle (In case of Ductile Iron) and each heat/batch (In case of Gray Cast Iron). These test bars are poured and machined as per the ASTM standards and then one of the test bars is tested for Tensile Strength, Yield Strength and Elongation (for Ductile Iron). These values are entered in the MTR format. The castings are allowed to go for further processing only after the lab has confirmed their acceptance. One test bar is stored as part of the foundry records. Test bars selected per the sampling plan in our IQC are sent to SIGMA for verification testing in USA.

Hardness:

The hardness values are checked not only on the specimen pieces but also on the final product. Hardness is checked for each heat and recorded on the MTR report.

DIMENSIONAL:

The foundry carries out dimensional checks with gauges (as per our QIP) prior to packing for dispatch. There is 100% check on critical dimensions.

HYDRO TESTING:

All fittings (100%) produced are now being hydro-tested prior to dispatch. We believe we are the only import source that is going this "extra mile" to assure trouble free service. All fittings are hydro-tested at one and one half times the rated pressure for 1 minute.

Quality Control in USA:



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The Foundries electronically transmit the MTR Report on a periodic basis to SIGMA which is reviewed by the SIGMA IQC (Internal Quality Control).

Based on the sampling plan provided for in the IQC procedure test bars are sent by the foundry over to SIGMA along with the shipment and SIGMA checks the Tensile, Yield and Elongation as a verification process. SIGMA also sends out these test bars to a third party testing agency for verification of the Test bars. All the results are logged and compared with the results submitted by the foundries in the MTR report.

Verification of the microstructure and hardness is also carried out at SIGMA.

DIMENSIONAL:

Fittings are selected by a sampling plan from each incoming shipment into our warehouses. These are gauged as per the requirements of the IQC.

HYDRO TESTING:

SIGMA under its IQC process hydro-tests selected fittings as per sampling plans to ensure that the process is under control. While the design and the initial casting from the original pattern is tested at 3 X working pressure (as required by AWWA), our fittings have passed a more rigorous testing by UL (which goes up to 5X till 6" nominal size) and FM (which requires 4X on all sizes). It is pertinent to note SIGMA supplies the widest range of UL and FM approved fittings to water works industries.

It is pertinent to note that all test and qualification data related to the production of our fittings and joint restraints is available for inspection and audit at our New Jersey facility.

STATISTICAL CONTROLS AND PERIODIC AUDIT

Additionally SIGMA provides to the foundry assistance in statistical analysis. We run statistical reviews of the MTR data to check the process reliability. In addition to monitoring the reliability, we also help the foundry to 'fine tune' the process control mechanism by giving them regular feedback through the SPC process. Over time we have reduced the standard deviation values for the physical properties to bring the production within a tighter band.

While the foundries are responsible for operating their quality systems, there are SIGMA inspectors routinely visiting each foundry to audit these systems and monitor the implementation of new initiatives. In addition to our efforts, the foundries undergo regular periodic inspections from third party bodies such as the Underwriters' Laboratories (UL) and Factory Mutual (FM).



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The objective of our engineering and technical management is to produce a first rate product that is consistent in quality irrespective of which country it is made. We succeeded in this challenging task by a careful selection of very good foundries and then through implementing a meticulous and disciplined regime using modern processes. A proof our success is the growing list of satisfied customers and users. We are proud to submit that New York City – which operates one of the largest water systems in the country – has selected SIGMA as a qualified manufacturer for their system.

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