Inspection and quality control of casting in the Ajaokuta steel company's foundry shop

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Abstract. The inspection of casting has dual purpose of ensuring that the product confirms to design requirements and of providing information needed for quality control in Foundry. This paper therefore clearly looked into the two components with a view to understanding important of inspection and quality control of production processes with a view to achieving quality castings which adherence to quality control principles. The study further discuss the importance of using computer for inspection and quality control analysis which has become necessary particularly as regarding the prediction of solidification patterns of casting and several alternative casting methods that can be simulated before the final method is chosen.

Keywords: Inspection, Quality Control, Casting Foundry Shop and Ajaokuta.

1 INTRODUCTION

Inspection is the application of tests and measuring devices to compare products and performance , with specified standard ,specified limit of variability and, therefore, is acceptable or unacceptable (defective) (Ihom, 2003) According to Parker and Trucken miller (1979)foundry inspection and tests are done both as controls on the process and as check on the product. Inspection always involves evaluating the quality of some characteristic in relation to a standard. The inspection of casting has the dual purpose of ensuring that the product conforms to design rearrangement s and providing information needed for quality control in the foundry.

2 STANDARDS AND THEIR COMMERCIAL IMPLICATION

The initial requirement for inspection is the establishment of standards reflecting the intentions of the designer, design in the broadest sense requires definitions of the product in term of physical shape and dimensions, composition and properties, and general quality. Inspection is based on permissible composition and mechanical properties which are capable of precise quantitative definition so that numerical tolerance limits can be prescribed. In other cases subjective judgments are needed.

Many explicit design requirements can be conceded in drawings and specifications casting may for example, be manufactured to a widely recognized specification such as a British standard in conjunction with drawings or pattern provided by the purchaser .Many formal specifications are, however, confined the definition of chemical compositions and/or mechanical properties ,whereas castings require further qualities implicit in the capabilities of the process the maintenance of these qualities, for example soundness and surface finish is frequently dependent on internal standards instituted by the manufacturer. These standards are

closely associated with commercial policy and may be set at a higher level than strictly necessary to meet the formal specification .standards must not on the other land be set at an unrealistic level in relation to the basic.

Capacity of the particular casting process; the economic implication of high standard must also be appreciated .Unnecessary tight compositional tolerance ,may entail additional raw material costs or higher rejection rates ,whilst the cost of more rigorous inspection procedure must it set be reflected in the selling price of the casting.

3.0 RADIOGRAPHIC AND OTHER SPECIAL TECHNIQUES

These could be expensive and should not be formally specified unless absolutely necessary .It is important that the significance and cost of these technique be fully appreciated by the purchaser whilst of great value to the founder for methods develop and for sample chucks on quality during productions they should where stipulated for routine inspection, be separately quoted and invoiced where ever possible.

4.0 MATERIALS AND PRODUCT TESTING PROCEDURES

Routine casting inspection normally involves geometric checking shape and dimensions, representative chemical analysis and mechanical properties are also often available. These measures are increasingly supplemented to various form of non-destructive testing hydraulic testing and proof trading .Since all such measures add to the cost of the product the, first consideration must be to determine the amount of inspection needed to maintain adequate control over quality. In some case, thus may require full examination of each individual casting but in other cases sampling procedures may suffice.

Whilst it is customary to perform at least a limited usual inspection on all casting ,detailed inspection maybe confined to critical points at which variation are likely to occur .It is in this respect that a full understanding of the foundry method on the part of the inspector can eliminate unnecessary routine. Certain cast dimensions are liable to vary only within narrow limits. Similarly detailed understanding of the service function of a casting clarified the relative importance of its dimensions and the significance of defects in different zones. The inspection procedure must therefore be adjusted to suit the particular circumstance surrounding each type of casting. If sampling is used, it must be appreciated that there can be no absolute assurance freedom from defects in an individual case, so that complete coverage is needed in critical applications where no further sorting will occur. In these cases where inspection is to be limited to certain features or to a proportion of total production ,full inspection maybe carried out on preliminary samples and during the early stages of production during and may be resumed if trouble is enduring later production runs

An important element in inspection and quality control concerns the identity of the casting examined .whilst may casting are manufactured with no attempt at prolonged identification a distinguishing mark of origin on each casting is a valuable aid to the maintenance of quality records. Abbreviated cast and serial numbers can be stamped at early stages on all save the smallest casting; the marking can often be retained throughout the life of the casting to provide permanent reference to its production and inspection, history metal stamping must be applied with desertion in view of the frequent incidence of factitive failure initiated at such stamps. It is essential to position then away from highly stressed region (Beeley 1982).

5.0 SHAPE AND DIMENSION

Visual inspection of each casting ensures that name of its features has been omitted or malformed by invaliding errors, short running or mistakes in fettling serious surface defect and roughness can be observed at these stages. Dimensional examination is then carried out against the drawings aided by jigs and template; tolerances on the cast dimension are normally invaded on the drawing. in some cases this operation can be combined with making

out particular care is in respect of dimensions incorporating datum surfaces. Errors involving these surfaces can produce consequential errors or inadequate machining cuts elsewhere on the casting .in cases where the weight of the components is critical a specific weight check may be this may also be required for casting purpose (Beeley 1982).

Where dimensional errors are detected in relation to general drawing tolerance their true significance must be determined .a particular dimension may be of vital importance but may on the other hand have been fortuitously included in blanket tolerance needed primarily elsewhere. A recommendation of the international organization for standardization stresses the desirability of stating functional dimensions on drawing so that tolerances are not restricted unnecessary.

In the inspection of production procedures involves inspection at different stages and process steps.

1. Raw materials inspection (chemical composition of pig iron, cropends, foundry returns, blanks of size and shape of sand grains)
2. inspection of pattern equipment, care boxer for dimension, condition of edges, fitting different parts
3. Sand properties mixture content gas permeability, strength etc measured periodically every 4 hours.
4. mound inspection for dimension, hardness, periodically
5. Inspection of cares for hardness, collapsibility and dimension.
6. meet composition and gas content in melt if required
7. pouring temperature measured by emission of pyrometer r optical pyrometer
8. Testing of metal sample cut from the casting or from testing casting (for tensile/ compressive strength, hardness, impact or bend test etc.
9. inspection of finished casting for surface finished dimension etc
10. It is important to note that quality control in foundry operation involves several inspection procedures and would require answerable man power and cost.

The casting dressed are then inspection for acceptance by the quality control section .the inspection makes check on the following

a) Size of pressure –tightness castings
b) Pressure on internal and external object (show cage blowholes cracks)
c) Mechanical structure of metals.

6.0 INSPECTION

This include x-ray examination, pressure testing and visual inspection, other are magnetic particles inspection and ultrasonic examination x-ray examination may be used to reveal blow holes sand spot and inclusion , internal shrinkage ,hot tears, cracks and internal chills. Any discontinuities within the metal affects the intensity of the radiation reaching the x-ray film and produce variation in the density of the photographic image (AMS,1964) for example are registered as darker areas on the film while heavy inclusion show up as light (Peter B ,2001).

7.0 PRESSURE TESTING

Pressure testing is required of all casting which must be leak proof or pressure tight. The cost is usually made by sealing the internal part is special fixture after which air or liquid pressure is applied. Leaks are revealed by either in the entire assembly into a water tank or by applying

a water soap solution to the exterior .in either case tank will be revealed by bubbles appreciating on the surface of the casting.

8.0 VISUAL EXAMINATION

Visual examination is simple inspection of the external surface of the casting by eye. The more obvious surface imperfection is revealed by this dimensional inspection using measuring instrument and inspection fixture may be part of the visual inspection. Taking a close look at the casting in (say) plate (a) and (b) below if by error, one interchanges the use of rise to that of boss surface imperfection will be seen on both casting .This is just one in thousands of daily imperfection generated in metallurgical plant industries.

9.0 MAGNETIC PARTICLES INSPECTION

The dry power technique of magnetic particle inspection is more widely used in the steel foundry that the wet technique although the wet technique is sometimes preferred for castings that require inspection relating to the casting surface (AMS1964).

10.0 ULTRA SONIC TESTING

Ultrasonic testing is useful because of its ability to reveal the location of a discontinuity once its presence has been indicated. This method of testing is a valuable adjunct to radiography because the depth of a discontinuity in a thick section usually cannot be determined by radiography. It is useful for ensuring casting wall thickness and for inspecting casting that are two thick for inspection by radiography techniques (Kurdumov A.V., Pikunovmv and Chursir V.M,1986).

11.0 SURFACE QUALITY AND FINISH

Quantitative standard are seldom adopted for the surface finish castings which are normally judged from visual examination alone. Numerical standards only however, be specified if required .The simplest evaluation is by visual comparison with a series of standard surface; these may be arbitrarily ground or may themselves have been quantitatively assessed by other means. Alternatives, a stylus measuring instrument may be useful to obtain representation of surface profiles. Such instruments are usually only suitable, however for distinguishing between relatively smooth surfaces such as these obtained in precision casting processes. They produce graphical representation of the profile or an integrated numerical value deprival from the total vertical movement of the stylus relative to a datum during a fixed length of traverse.

12.0 CONCLUSION

In order to carry out all the necessary operation on post casting product care needs to be exercised that material are properly meet chemical standards before charging them into the furnace .The importance of inspection of castings can not be over emphasized in the casting process in foundry operation .castings are inspection thoroughly to fine the presence of internal flaws is well as external details .Various method of inspecting casting have been discussed. The paper has clearly posited that inspection of casting has the dual purpose of ensuring that the product conforms to design requirement and providing information needed for quality control in the foundry. The inspection process is made up of visual inspection and instrumental inspection.

REFERENCES

Beeley, P.R (1982) Foundry technology, fourth edition the Camelot press LTD. South ampton.p250-283

Broom, J.R (1994) Foseco Foundrymen's handbook tenth edition pg 284-289
Packer K.F and Truckenmiller W.C (1979) Foundry quality control third edition Mcgraw – hill Book Company, New York, 34
R.K Jam (2009) Production technology (Manufacturing processes, technology and autonatin) 17th edition pg 135.