CASTING WEIGHT OPTIMISATION

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The need of the day is to reduce cost of components by reducing input / final weight of components. Here, Grey & Nodular Iron casting components are considered.

The Methodology

PHASE-I

a) Collection of Data for the Casting

Weight of Ok Castings: Castings, duly fettled and in finished condition, need to be weighed for minimum 20 Nos. preferably from different lots from same pattern equipment with same process of manufacturing. For the small casting upto 5 kg., the weight shall be with 5 gms least count and for larger castings above 5 kg., 50 gms would be least count The average weight needs to be noted as initial weight of the casting.

Casting Manufacturing process: Casting manufacturing process type is to be noted in detail for core making process like Hot box; Oil sand or Shell sand cores; Moulding process like hand moulding, Jolt & squeeze or High pressure moulding-Core assembly in mould should be mentioned like manual, auto or pre assembled; Metal pouring like manual or press poured and casting knockout time. Ensure same manufacturing process for the Casting all the time.

Casting Rejection: Actual rejection data of one year ago occurred for the casting in details for all parameters like blow holes, sand inclusion, unclean machining areas, porosity, casting mismatch, misrun, damage etc should be collected. This rejection data need to be collected at foundry stage and after machining.

Casting Layout: Casting for all dimensions for 5 Nos. should be laid out and the dimensions should be averaged out. Machining-related dimensions should be checked out for 10 Nos. and the dimensions be averaged out. These should be noted as initial dimensions.

Machining Process: Other important recordings should be machining process sequence from first to last operation and types of machines used like conventional or CNC. Depth of machining cut, number of passes & machining cycle time for the casting operation-wise are also to be recorded.

Actual use of the Casting: Usage of the casting at assembly level should be studied and the important areas and critical dimensions of the casting as far as assembly to be noted.

Cost of Individual Casting: Data for the selling cost of casting to be collected and prioritised.

Volume of Individual Casting: Data for Volumes in numbers being sold also to be collected.

b) "Foundry Discipline" in the Casting Manufacturing Process

Cores: Ensure Cores are fully filled, cured and dressed.

Moulding: Ensure Moulding boxes are in good condition; Correctness of Bushes, Pins & Closing pins on moulding boxes, Pattern Match Plates and their proper clearances should also be ensured. Further, points to be ensured are: Patterns are properly fixed on match plates with least mismatch, fully tightened, no undercuts or burrs, appropriate drafts, no sharp corners, no loose fittings, Risers & Gas pins are perpendicular. Ensure moulding sand compactness in moulds with no loose sand, cracks or erosions. Care should be taken so that all sand properties are in place and cores are properly placed in mould.

Melting: It should be ensured that proper charge mix with pre decided sequence is done, temperature; melt properties before tapping are proper and mould fillings are also in accordance with stipulated planning.

Casting Knockout, Shot blasting & Fettling: It should be ensured that there is no damage to casting during Knockout. Casting is to be shot blasted and fettled with care.

c) Data Analysis and Prioritising

After analysis of the data collected for the Castings priority should be for High Value / High Volume / High weight components. It is better to start with top few components for improvement.

d) Prepare Casting 3D Model (CAD)

Many of the component 'casting' drawings are available in conventional 2D. These drawings are to be converted into 3D Model with the help of CAD keeping in mind machining stock to be minimum 2 to 2.5 mm. While deciding the machining stocks, one has to keep in mind that machining stock is to be kept 2.5 mm on top side of castings and 2 mm on bottom side of the castings as manufactured in foundry. In foundry manufacturing process, critical dimensions of machining are required for process drafts. This 3D model can show actual weight of casting once material density is provided to CAD. This gives e casting weight difference for further calculations.

e) Start Activity

Once, the component is short-listed for improvement, the data collected earlier for average machining stocks and wall thickness should be analysed and compared with 3D model drawing. Next 5 existing components should be machined to expected dimensions and weighed. These castings should then be taken as ' expected future' castings and machined fully. These should then be checked for any unclean casting patch or any casting deficiencies. This gives confidence level for reducing the stocks. Similarly, the areas of improvements on castings can be short-listed.

f) Actions

Actions should be taken on existing or any previous not-in-use Pattern / Die for desired changes. Five components out of these toolings may be made and verified for machining operations. If found OK, bigger lots of 100 & 500 Nos. may be taken up. Results for machining, rejections due to change to be verified and if there is no abnormality, one can go for permanent toolings.

g) Audit

Audit for the changed dimensions and rejections is the next step followed by updating of the casting / Tooling drawings and related documents.

Phase II

Reduction in Casting Wall Thickness and Removal of unwanted Mountings on Castings

End Use of the Cast Machined Component: The end use of the component at Assembly level and at Function level should be studied to prepare the list of machined faces & areas. Questions should be asked whether the machining is really required at non-functional areas. Can the machined area be kept as Cast since the casting technology has improved a lot? Can the wall thickness be reduced by strengthening the component with higher grade of material, which is now a days available. Or can the Ribs be provided or alternative design be looked into. All these will result into reduction in weight of the cast component.

CAE Analysis: CAE of the existing Cast machined components should be conducted to ascertain whether the component is over-designed, if yes, the design to be optimised which will result in the component casting weight reduction.

Bench Mark Data: Benchmark data from other such components used by competitors for same type of castings should be collected and its end use should be studied for improvement areas.

Unwanted Lugs / Mounting bosses: At times, the castings have lugs or mounting bosses which are not required due to change in design of system. Such unwanted mountings on castings can be removed which will result in casting weight reduction.

Action: Samples with change configuration should be made and validated. If OK, existing toolings should be modified or new toolings should be made.

Audit: Audit for the changed dimensions and record is the next step followed up by updating of the casting / Tooling drawings and related documents.

Conclusion

The author has carried out this exercise on various castings during last two years which has resulted into huge savings in terms of casting weight (Material & Cost).

Examples are —

Component	Weight Reduction Kg.	Annual Volumes Nos.
Brake drums	1 to 1.6	2,00,000
Fly wheels	0.4 to 2	1,50,000
Clutch Housing	1.8	70,000
Cylinder Head	1.6	1,00,000
Cyl Block	1.5	1,00,000
Engine Cover	0.6	60,000
Hub	0.4	80,000
Housing	0.4	70,000