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Welded to Weld-less Component

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Abstract: The main aim of the project is to contribute in Customers drive to compete with Global market players in terms of Quality, aesthetics and cost. To ensure quality consistent and first time right. To improve the productivity of the company. To reduce the pollution in environment and adopt the environment friendly processes. To minimize the dependency of operator. To reduce the cost of the component and improve aesthetic body of the component. The problems faced due to welding must be eradicated. This can be reduced by weld-less component. The task with this project was to find a new solution concept for modification in existing design and product. The concept uses today for their product (Diesel engine cover) is based on welding the child parts to construct the one product.

Keywords : Cost, Quality, Productivity, Welding, Weld-less

I. INTRODUCTION

The main aim of the project is to contribute in customers drive to compete with global market players in terms of quality, aesthetics and cost. To ensure quality consistent and first time right .To improve the productivity of the company. To reduce the pollution in environment and adopt the environment friendly processes. To minimize the dependency of operator. To reduce the cost of the product and improve aesthetic body of the product. The problems faced due to welding must be eradicated.

Noise and vibration are the major responsible factors towards human comfort level. to enhance the human comfort, it is very necessary to reduce noise & vibration level due to fitting of child parts in air cleaner mounting bracket, where noise & vibration are more due to welded connections. the welding process is expensive due to high technology robots and time consuming. during manufacturing of air cleaner mounting bracket, are exposed to large thermal stresses while welding. this stresses weakens the materials, produces the defects, which can take shape of small pieces of materials, other defects can occurs in welding seam & they must be required manually. however, air cleaner mounting bracket should not be manufactured by casting because of content of high quality materials in casting process.

The main good in development of air cleaner mounting bracket, is to analyse several solutions weldless. the solution that are subject for further development are prepared during the primary construction with e.g. cad etc.

The task with this project was to find a new solution concept for modification in existing design and product. The concept that JAAS Automotive uses today for their product Air Cleaner Mounting Bracket is based on welding the child parts to construct the one product.

The product development model that is used in this project is produced Air Cleaner Mounting Bracket For this project have the parts “Principal Construction” and “Primary Construction been used.

During the principal construction has a product definition been made that should be satisfied by the following solutions concept was determined. Several solutions were designed and evaluated by the project members and co-operation with the supervisors at JAAS Automotive. The solutions that were subject for further development were prepared during the primary construction with for example CAD, CATIA, and ANSYS.

Weldless solution concepts were the results from this thesis work. All of the solution concept contain weldless diesel engine cover (Bracket) used for the protect the engine. The main difference between them is that the Bracket is designed and manufactured in different ways.

II. LITERATURE REVIEW

S.B. Borole1, Dr. G.V. Shah, Design Modification and Analysis of Engine Exhaust Manifold in their research work carried out The Objective is to present experimentation, modelling and analysis of exhaust system fitting weld less by using FEA. Modelling is done using PRO/Engineer Cero. Analysis is carried out by using ANSYS. The optimization of cast and fabricated manifolds (single or dual wall design) requires different techniques, due to the production restrictions. The locations where failures occur, on both the exhaust manifolds (cast or fabricated) and exhaust manifold gaskets, are predicted with high degree of accuracy.

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From the study it is seen that the different solution concept is result from this work. All of the solution concepts contain end shaped pipes that provides the sealing area against the engine. The main difference between them is that the flange is designed in different ways. Different techniques are needed for the optimization of cast and fabricated manifolds, because of production restrictions. This problem is already been addressed and a procedure has been implemented.

The manual and automatic optimization methods have distinct advantages and disadvantages. A cost effective solution is delivered by a combined methodology, which also results in a failure-free exhaust manifold design.

III. PROBLEM STATEMENT

A. Problems due to Customers drive to compete with Global market players in terms of Quality, aesthetics and cost.
B. Quality problems Consistent and First Time Right.
C. Productivity is low in welding products.
D. Welding causes environment pollution.
E. To adopt just in time approach.
F. Minimize dependency on operator.
G. To reduce the cost of the product.
H. Problem faced due to Welding.

IV. METHODOLOGY

The two most widely used Six Sigma methodologies are DMAIC and DMADV. Both methods are designed so a business process will be more efficient and effective. While both of these methodologies share some important characteristics, they are not interchangeable and were developed for use in differing business processes. Before comparing these two approaches in more detail, let’s review what the acronyms stand for.

A. DMAIC: Define, Measure, Analyze, Improve, Control
B. DMADV: Define, Measure, Analyze, Design, Verify

In general, DMADV is associated with new services and product designs; it may not always work with existing products and processes. When there is no existing product, DMADV can be implemented to design the product or process. Another way of looking at it would be to use DMADV when a process improvement doesn’t meet expectations or simply fails.

DMAIC is used on a product or process that already exists but is no longer meeting customer needs and/or specifications. Companies without previous Six Sigma experience may want to enlist help from professionals such as Six Sigma Black Belts and Master Black Belts, professionals who can help make the best choice between DMAIC and DMADV.

C. Phase I : Customer Needs

1) To improve engine aesthetics by welded to weld less design of fabricated parts .
2) Process standardization.
3) To achieve quality consistent and first time right.
4) Delivery improvement by enhancing productivity
5) cost saving.

D. Phase II : Voice Of Customer

1) First time right with zero ppm target
2) Benchmark with automotive parts for asthetics.
3) 100% on-time delivery
4) Minimum 30% cost saving.

E. Phase III : Identify Part & Functional Requirements

1) Conceptual design
2) Identify part – process & functional requirement
3) Develop prototype

1) Identified Part-

a) Part name: air cleaner bracket
b) No. Of sub assembly parts: five
c) No. Of operations: thirteen
d) Weight of mounting part: 3 kg.
e) Lead time: 2 weeks
f) Weight of bracket : 2.3 kg.
g) Quality :weld distortion and dimensional inconsistency
h) Aesthetic : poor

Fig. 1 Welded Component

F. Phase IV: Testing and Validation

1) Develop design details
2) Develop tool design
3) Proto-build
4) Develop control plan
5) Tool design & manufacturing
6) Design validation.
7) Stimulation
8) Process control plan

G. Design

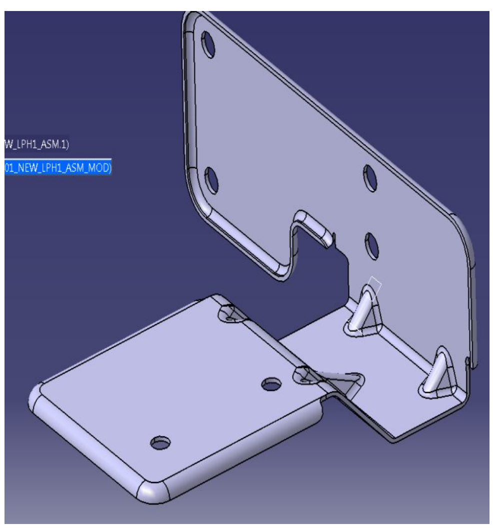

Fig. 2 Design of Weldless Component

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H. Testing and Validation

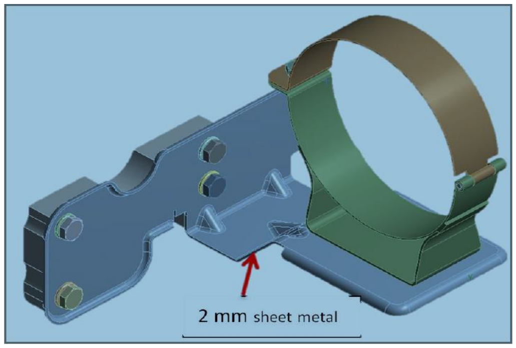

Fig. 3 Load acting on component

1) FEA Report – Recommended to increase in Stiffness.
a) Action - Design reviewed and Stiffness increased by providing flange all across the blank profile instead of segmented flange. Continuous uniform flange with embossed ribs added to strengthen.
b) Weak zones. -Functional testing and validation done and received approval for implementation

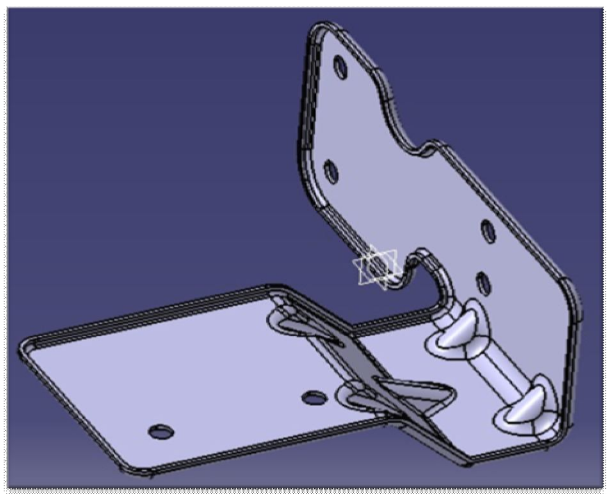

Fig. 4 Component with uniform flange

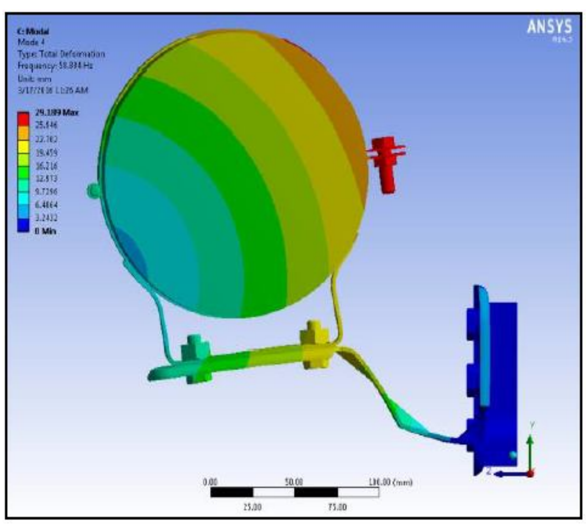

Fig.5 FEA analysis of component

I. Phase V: Verify and implement

1) Review of measures

2) Full phase implementation

3) Identify scope for horizontal deployment

Fig. 6 Weldless developed component

1) Review of measures

Measure	Existing Design (welded)	New Design (weldless)
Aesthetic	Poor	Excellent
Delivery	Lead time of 2 weeks	Lead time of 48 Hours
Quality	Part distortion and inconsistency in dimensions due to welding	Achieved consistent and first time right quality
Process	Hazardous to Environment	Environment friendly
No of child parts	05	00
No of operations	13	07
Weight of part	2.03 kg	730 grams
Weld run	1 meter	Weldless Part
Operator skill	Qualified and skilled welder	Trained semi skilled operator
Cost	260.54	93.38

Table. 1 Review of measures

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2) Costing of Welded Component

Part. No. :-2H.277.24						Description :-	BRACKET	
Supplier :-JAAS AUTOMOTIVE INDIA PVT LTD								
(A) Raw Material Cost :-								
Component	Material Specification	IS 2062 GR A			WEIGHT	QTY	Material	Material Cost
Name	THICKNESS	LENGTH	WIDTH		(kg) (2)		Rate/kg (1)	(Rs.) (1 x 2)
MAIN BRACKET (SR NO 1)	4	309	238		2.312	1	46.00	106.36
RIB 1	4	82	78		0.101	2	46.00	9.25
RIB 2	4	128	76		0.153	1	46.00	7.03
RIB 3	4	146	28		0.064	2	46.00	5.91
							Sub Total (A)	128.56
(B) Boughtout Parts Cost :-								
Component	Part No.				Supplier	Unit Price	Quantity	B'out Parts Cost
						(Rs.) (1)	(Nos.) (2)	(Rs.) (1 x 2)
							Sub Total (B)	0.00
(C) Processing Cost :-								
Component	Part No.				Operation Details			
Name	unit	Size	THK	rate	No of Operation	Machine	Cost	
SHEARING / CROSS SHEARING	WT	2.630		2.5	1	SHEARING M/C	6.57	
MAIN BKT BLANKING	NOS	1		3	1	200 T	3.00	
MAIN BKT PIERCING	NOS	1		3	1	200 T	3.00	
MAIN BKT FORMING	NOS	1		3	1	200 T	3.00	
RIB 1 BLANKING	NOS	1		2	2	150 T	4.00	
RIB 2 BLANKING	NOS	1		2	1	150 T	2.00	
RIB 3 BLANKING	NOS	1		2	2	150 T	4.00	
TACK WELD	NOS	22		0.5	1	CO2 WELD	11.00	
FULL WELD	PER MTR	1		30	1	CO2 WELD	30.00	
DEBURRING AND FINISHING	NOS	1		5	2	MANNUAL	10.00	
PAINTING							10.00	
						Sub Total (X)	86.57	
					Scrap Generated	Scrap Rate	Scrap Cost	
					(Kg) (4)	per Kg (5)	6 = (4 x 5)	
					0.000	20.00	0.00	
					Processing Cost (C = X - 6)		0.00	
(D) Assembly / Testing Cost (*If applicable*)							0.00	
(E) Logistics Cost :-								
Transportation Cost / Piece (*If applicable*)							0.00	
Packaging Cost / Piece (*If applicable*)							3.00	
						Sub Total (E)	3.00	
(F) Profit :-								
ICC ON A	2.50%						3.21	
REJECTION (A+B+C+D)	1.00%						2.15	
OVERHEADS ON (A+B+C+D+E)	5.00%						10.76	
PROFIT ON A	10.00%						12.86	
PROFIT ON (B+C+D+E)	15.00%						13.44	
							42.41	
TOTAL OFFER PRICE (Rs.)					260.54			
(A + B + C + D + E + F)								

Table. 2 Costing of welded component

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3) Costing of Weldless Component

Part. No. :-2H.277.24						Description :-	BRACKET	
Supplier :-JAAS AUTOMOTIVE INDIA PVT LTD								
(A) Raw Material Cost :-								
Component	Material Specification		IS 2062 GR A		WEIGHT	QTY	Material	Material Cost
Name	THICKNESS	LENGTH	WIDTH		(kg) (2)		Rate/kg (1)	(Rs.) (1 x 2)
MAIN BRACKET	2	308	249		1.206	1	46.00	55.46
							Sub Total (A)	**55.46**
(B) Boughtout Parts Cost :-								
Component	Part No.				Supplier	Unit Price	Quantity	B'out Parts Cost
						(Rs.) (1)	(Nos.) (2)	(Rs.) (1 x 2)
							Sub Total (B)	**0.00**
(C) Processing Cost :-								
Component	Part No.				Operation Details			
Name	unit	Size	THK	rate	No of Operation	Machine	Cost	
SHEARING / CROSS SHEARING	WT	1.206		2.5	1	SHEARING M/C	3.01	
MAIN BKT BLANKING	NOS	1		2	1	150T	2.00	
MAIN BKT PIERCING	NOS	1		2	1	150T	2.00	
MAIN BKT FLANGE FORMING	NOS	1		1.5	1	150T	1.50	
MAIN BKT FORMING	NOS	1		1.5	1	150T	1.50	
DEBURRING AND FINISHING	NOS	1		2	1	MANNUAL	2.00	
PAINTING							8.00	
						Sub Total (X)	**20.01**	
					Scrap Generated	Scrap Rate	Scrap Cost	
					(Kg) (4)	per Kg (5)	6 = (4 x 5)	
					0.000	20.00	0.00	
					Processing Cost (C = X - 6)		**0.00**	
(D) Assembly / Testing Cost (*If applicable*)							**0.00**	
(E) Logistics Cost :-								
Transportation Cost / Piece (*If applicable*)							0.00	
Packaging Cost / Piece (*If applicable*)							3.00	
						Sub Total (E)	**3.00**	
(F) Profit :-								
ICC ON A	2.50%						1.39	
REJECTION (A+B+C+D)	1.00%						0.75	
OVERHEADS ON (A+B+C+D+E)	5.00%						3.77	
PROFIT ON A	10.00%						5.55	
PROFIT ON (B+C+D+E)	15.00%						3.45	
							14.91	
TOTAL OFFER PRICE (Rs.) (A + B + C + D + E + F)					**93.38**			

Table. 3 Costing of weldless component

V. MATERIAL USED

A. Material Selected Hot Rolled medium and high tensile structural steel

1) *Specifications:* Micro-Alloying Elements — Elements, such as niobium, vanadium and titanium added singly or in combination to obtain higher strength to weight ratio combined with better toughness, formability and weldability as compared to unalloyed steel of similar strength level.
2) *Weldability:* A metallic substance is considered to be weldable by a given process and for the given purpose, when metallic continuity to a stated degree can be obtained by welding using a suitable procedure, so that the joints comply with the requirements specified in regard to both their local properties and their influence on the construction of which they form a part.
3) *Controlled Rolling:* A hot rolling process in which the temperature of the steel and its reduction ratio are controlled, particularly during the final rolling passes, in order to achieve fine grain microstructure and optimum mechanical properties. Normalizing Rolling: A hot rolling process in which the final rolling passes are carried out at a suitable temperature equivalent to normalizing temperature, followed by cooling in air to a temperature below the transformation temperature, in order to produce a structure, analogous to that obtained by a separate normalizing treatment of hot rolled product.
4) *Grades:* There shall be nine grades of steel. For grades E 250 to E 410, there shall be four sub-qualities (A, BR, B0 and C) and for grades E 450 to E 650, there shall be two sub-qualities (A and BR). Sub-qualities A, BR, B0 and C indicate requirement of impact test and mode of de-oxidation as indicated below:

5) A : Impact test not required, semi-killed/killed
6) BR : Impact test optional; if required at room temperature; semi-killed/killed
7) B0 : Impact test mandatory at 0°C, semi-killed/killed
8) C : Impact test mandatory at –20°C, killed While placing the order, the steel should be designated by 'Grade Designation' and 'quality'.

VI. CONCLUSION

As per the discussion and the selection of the proper cycle amongst DMAIC and DMADV, DMADV is of better perspective and the analysis of the noise and vibration in Air Cleaner Mounting Bracket tends to have better output relative to analysis by DMAIC cycle. After the understanding of the market needs from various sources, the problem in the bracket weld was identified, and then by process standardization, the best possible outcome is being delivered. Initially the concerned bracket was welded with child parts arranging into an assembly, and the disadvantages were the weight, which was 2.3 kg, and the lead time, which was 2 weeks, resulting into poor aesthetics. After testing and validation of the new product, which has a single structure, the weight was reduced to 0.70 kg, and the lead time to 48 hours. Moreover, the newly validated product was achieved with higher and consistent quality.
Now the main part being the cost. The direct cost reduction is 23.76% which plays an important role. Thus, at concluding part, the said product manufactured part is better than the former part with welds and yields better operating characteristics with reduction in maintenance costs.

VII. ACKNOWLEDGEMENT

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