

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

Improvement of First Time through in Heater

A.K.M. Mohammed Kamil¹, P.S. Gokulnath², R.S.Uthayan³, Dr.M.Maran⁴

U.G. Student, Department of Mechanical Engineering, Velammal College of Engineering and Technology ,
Viraganoor, Tamil Nadu, India¹,

U.G. Student, Department of Mechanical Engineering, Velammal College of Engineering and Technology ,
Viraganoor, Tamil Nadu, India²,

U.G. Student, Department of Mechanical Engineering, Velammal College of Engineering and Technology ,
Viraganoor, Tamil Nadu, India³,

Associate Professor, Department of Mechanical Engineering, Velammal College of Engineering and Technology,
Viraganoor, TamilNadu, India⁴,

ABSTRACT: Nowadays there is a dramatic increase in the use of automobiles and hence many automotive industries have been established. These automotive industries are competitive in producing better automotive parts both in quantity and quality. Some of the parts are heater, radiator, condenser, intercooler, exterior and interior components. One of the most important parts is Heater. In automotive industries, heaters are manufactured in large quantity and with maximum best quality that they can provide. Heaters are manufactured by Press, Fin mill, Core building, CAB furnace, etc. The purpose of this project is to increase the First Time through (FTT) which means that reduction in the wastages (Scrap) at the first time process (before rework). The Increase in First Time Through (FTT) will leads to Increase the profit and decrease the loss. These problems can be solved by providing some small changes in the design of some component to the required level to increase the FTT. We modified the dimension of the cap to meet the required specification. That leads to increase in FTT.

KEYWORDS:First Time Through, Flux, Gauge, Heater.

I. INTRODUCTION

We did our final year project in Industry. There we saw all process of production of components. They are producing Heater, Compressor, Condenser, Radiator, Evaporator, Intercooler and many more. In heater production First Time Through is very low that is 70%. Out of 100 Heater production 30 Heater are Not Ok. So, we consider this as a major problem. Because now a days most of industry try to achieve 6 Sigma in there production. If we say this heater production in sigma level, that is only 2 sigma. So we Analysed process of heater production. And finally we resolved.

II. LITERATURE REVIEW

In HVAC systems, ensured the perfect thermal comfort of the vehicle by using heating, ventilating and other air conditioning systems. Increasing the efficiency due to the Modern internal combustion engines(ICE) with fossil fuels dissipate less heat cooling systems to the engine. In winter period there is difficult to start the engine. Excess of heat required to start the engine and are unable to provide the amount of heat to a comfort level[12]. Different technologies now came to provide the heat easily and quickly for a thermal comfort level. Earlier method there is many losses obtained. Out of 100%, 60% are losses and also increases the inlet air temperature. This method having the many disadvantages. Some of the heating devices are required to improve the heating method[16]. The properties will be improved the specific thermal and electrical properties. PTC heater is used to increase the specific thermal and

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

electrical properties. PTC heaters are operate while the engine is running. Due to the exhausted heat there is major loss occurred in a gasoline fuelled vehicles. Now a day all the vehicles equipped with PTC heater to improve the heating method. PTC materials having the high density polyethylene, polymeric and titanate ceramic materials. It is having the high resistance and power dissipation characteristics[1],[2],[5],[7],[8]. After the period of years theoretical and experimental effect have been developed in the heater effect[4],[6],[7]. A new innovation over through the PTC heaters is PTC thermistors.

III. MANUFACTURING OF HEATER

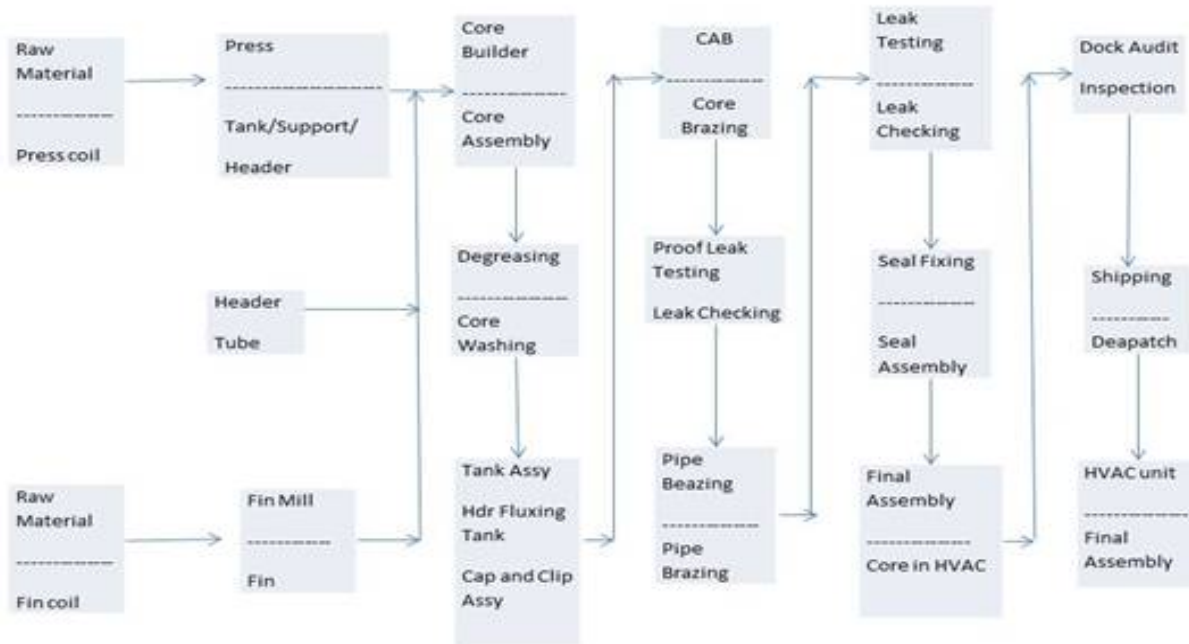


Fig 1: Heater Manufacturing process

This process start with raw material and end with Final Assembly. Raw material is aluminium which pressed and get required shape in the press machine like tank, support and Header. Header, tube and fin assembled in core builder and send to degreasing to remove oil content, acid and dust. After it will send to tank assembly. There 2 tanks at the end of header assembled and 4 caps fitted at end of tank. In that 2 caps are open cap in one side. And 2 caps are close cap in another side. In Controlled Atmospheric Brazing(CAB) all parts assembled will jointed together. And proof leak test done to test leakage. Then pipe is brazed in open cap side. Again leak testing done between open cap and pipe. Then seal is fixed to arrest shacking in engine while fitted in car. After HVAV assembly dock audit done and shipped to HVAC unit.

IV. PROBLEAM IDENTIFICATION

In Industry many types of heater are produced. Following are types of heater

- PA/B517
- BA
- HA
- A-Entry
- MCI /W201

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

- GS

In this W201 type heater FTT (First Time Through) is very low. That is out of 100 component production 30 parts are defective. It has only 70% FTT. So this may concenter as a major problem. Because if the heater is damaged after fitted in the car. Then the whole engine damaged. So that the company which produce heater must give a penalty for that. Out of all component heater only have less cost and more penalty.

V. EFFECT OF PROBLEM

VI.

The first time through of the W201 heater core is less than 70%. We have calculated First Time Through (FTT) at the proof leak test.

5.1.1 FTT for November

Total parts tested	=2186
Total ok parts	=1913
Total Not ok parts	=255
FTT	= (Total ok parts/Total parts tested)*100%
FTT	= (1913/2186)*100
FTT	=0.833*100
FTT	=83.3%

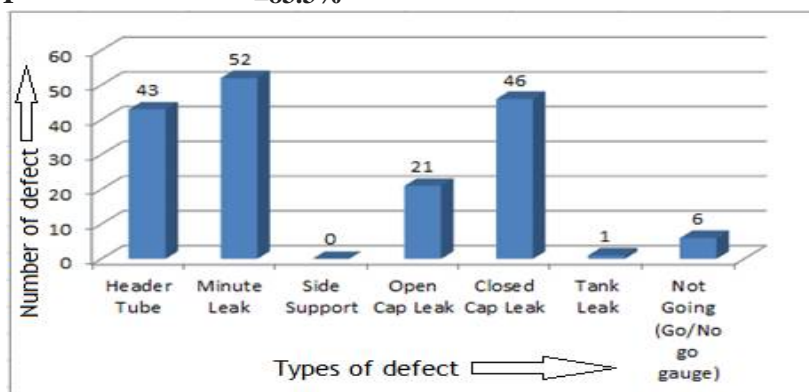


Fig2:Defects for November month

Above Figures show defects occur in November month in header production. Which is identified by Proof Leak testing. This is drawn from data in table 1. In this minute leak is more that is 52 parts are rejected due to minute leak. This is unable to detect. This may happen due to small crack, while production of heater. Closed cap and header tube leak also more.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

W201 PROOF LEAK TEST DURING NOVEMBER 2017																															
Description/Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
Ok	114	155	0	0	0	0	323	0	120	194	0	0	0	0	0	142	353	0	0	0	0	224	283	23	0	0	0	0	0	0	1931
Not Ok	8	10	0	0	0	0	62	0	3	4	0	0	0	0	0	8	35	0	0	0	0	26	22	77	0	0	0	0	0	255	
Header Tube	1	1	0	0	0	0	6	0	0	0	0	0	0	0	0	5	13	0	0	0	0	10	5	2	0	0	0	0	0	43	
Minute Leak	2	5	0	0	0	0	4	0	1	1	0	0	0	0	0	3	8	0	0	0	0	10	16	2	0	0	0	0	0	52	
Side Support	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Open Cap Leak	4	1	0	0	0	0	2	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	1	9	0	0	0	0	0	21	
Closed Cap Leak	31	2	0	0	0	0	3	0	1	0	0	0	0	0	0	0	5	0	0	0	0	0	0	4	0	0	0	0	0	46	
Tank Leak	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	
Not Going (Go/No Go Gauge)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	6	
Total	160	174	0	0	0	0	400	0	126	199	0	0	0	0	0	158	424	0	0	0	0	270	327	117	0	0	0	0	0	2355	

Table 1: W201 Proof Leak Testing During November 2017

Above table is tabulated from Proof Leak testing data for W201 heater type. Daily there are three shift. We make that as a single day by adding all the data. Not ok part totally 255 in this month. From date 22 to 24 defects are more. And at last date 24 defects are 77 which is highest in that month. Root cause for this is due to minute leak and header tube leak

5.1.2 FTT for December

There is no W201 heater core production during December month.

5.1.3 FTT for January

Total parts tested =4746
 Total ok parts =3148
 Total Not ok parts =1598
 FTT = (3148/4746)*100
FTT =66.329%

From the above data we can see that FTT of W201 is decreasing

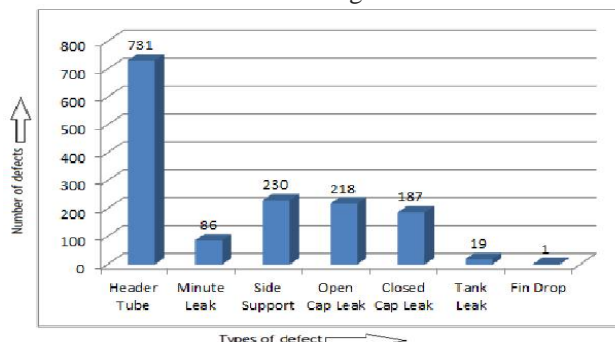


Fig3:Defects for January month

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

In January month Header tube leak is more that is 781 parts defect. Totally 1602 parts defected in that month. So 48.75% defect due to header tube leak. So this consider as a root cause in that month. Date 6 and 8 is more defect in header tube. So it depends upon that time only.

W201 Proof Leak Test During January 2018																																	
Description/ Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	
OK	0	0	0	128	203	125	0	244	84	73	577	328	0	0	0	0	0	0	0	217	0	230	237	369	333	0	0	0	0	0	0	0	3148
Not Ok	0	0	0	115	49	370	0	301	334	99	74	43	0	0	0	0	0	0	0	54	0	70	78	10	5	0	0	0	0	0	0	1602	
Header Tube	0	0	0	95	36	294	0	285	9	0	0	3	0	0	0	0	0	0	0	1	0	4	1	2	1	0	0	0	0	0	0	731	
Minute Leak	0	0	0	13	1	10	0	9	24	1	3	10	0	0	0	0	0	0	0	4	0	4	4	3	0	0	0	0	0	0	0	86	
Side Support	0	0	0	0	4	43	0	0	181	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	230	
Open Cap Leak	0	0	0	3	8	25	0	3	58	0	11	12	0	0	0	0	0	0	0	18	0	30	48	1	1	0	0	0	0	0	0	218	
Closed Cap Leak	0	0	0	2	0	0	0	19	42	0	15	18	0	0	0	0	0	0	0	32	0	31	25	0	3	0	0	0	0	0	0	187	
Tank Leak		0	0	1	0	0	0	1	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
Fin Drop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	357	301	867	0	862	732	173	697	414	0	0	0	0	0	0	0	326	0	370	393	387	343	0	0	0	0	0	0	6222	

Table 2: W201 Proof Leak Testing During January2017

Above table is tabulated from Proof Leak testing data for W201 heater type. Daily there are three shifts. We make that as a single day by adding all the data. Not ok part is 1602. And ok part is 3148. Not ok part is highest in date 9 which is 334. In that side support leak is more. Header tube leak is more compare to other leak. So this consider as a major defect in this month.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

VII. ROOT CAUSE DESCRIBED BY FISHBONE DIAGRAM

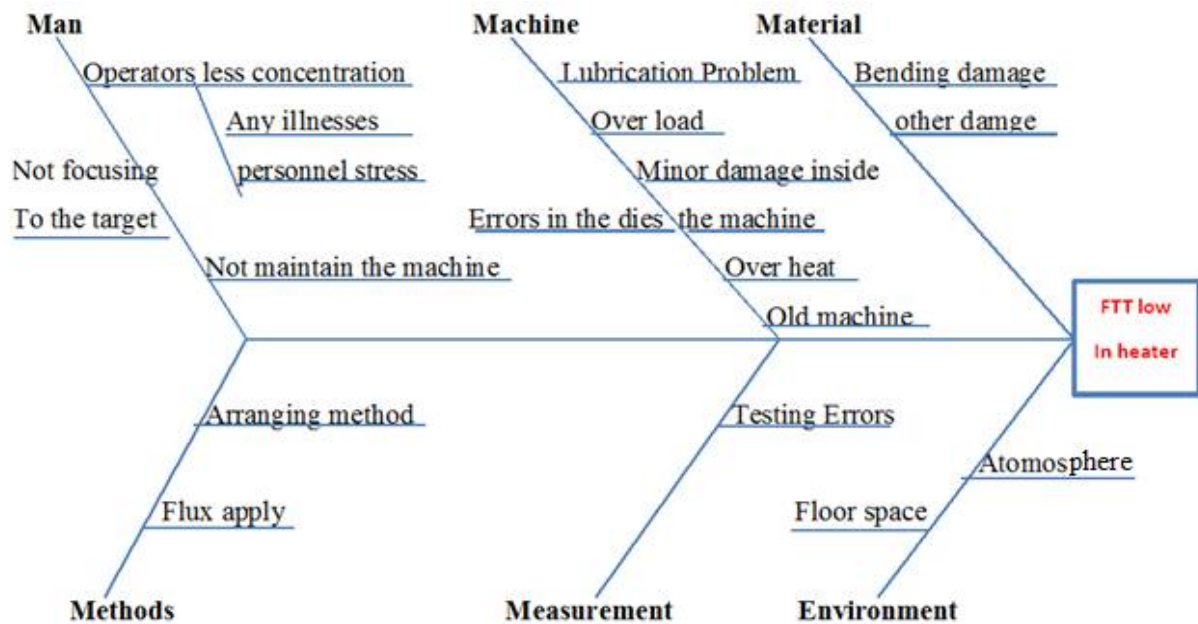


Fig 4: Fishbone diagram

6.1 MAN

6.1.1 Operators less concentration

A) Any Illnesses

Due to continue work of labour they may tired that may cause illnesses of labour.

B) Personnel stress

Due to personnel stress of labour their concentration decreased in work. Heater core must handle like a child. But they handle in improper way. That is while fit in the gauge they hit the core. Due to this activity of labour, heater core will damaged.

6.1.2 Not focusing to the target

In the company there are three shift. In their three different people are working. So each people have their own skill. Due to unskilled labour the error will be happened.

6.1.3 Not maintain the machine

Due to improper maintenance of machine that may repair. And their component may damage.

6.2 MACHINE

6.2.1 Lubrication problem

Due to improper lubrication or insufficient lubrication machine may heated that result in the wear and tear of machine components.

6.2.2 Overload

Machine must load with in the limit if it loaded beyond the limit that may cause repair of machine.

6.2.3 Minor damage inside the machine

Due to continue work of machine that may cause to create minor damage inside of the machine.

6.2.4 Errors in the die

This may cause because of many reasons like continuous running of machine, improper maintenance of machine, due to insufficient lubrication and more.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

6.2.5 over heat

Machine gets over heat due to insufficient lubrication or continuous running. This may cause wear and tear of the machine.

6.2.6 Old machine

Due to ageing of machine that may cause wear of most of the components.

6.3 MATERIAL

6.3.1 Bending damage

In heater production most of the raw material are aluminium. While bending shape production due to improper bending of aluminium machine parts may damage.

6.3.2 Other damage

Other damages like thickness more in the material, Improper dimension of raw material in the machine and so on.

6.4 METHOD

6.4.1 Arranging method

In early method of flux apply done by dipping whole heater core in flux. But it consumes more flux and also it take more time to dry. So now flux is applied using brush. While brazing process heater is arranged in the furnace one row after another. One row must arranged with three heater. But it have the space to arrange more. So if it loaded with more than three in the row that may cause improper brazing.

6.4.2 Flux apply

Flux is applied in only one side of the heater core. This may result in another side not brazed.

6.5 MEASUREMENT

6.5.1 Testing error

After heater production, dimension checked by gauge. Most of the W201 heater core not fitted properly. This may happened due to improper dimension of gauge or misalignment.

6.6 ENVIRONMENT

6.6.1 Atmosphere

Due to dust in the surrounding that may mix with lubricant result in poor lubrication.

6.6.2 Floor space

Due to more scarp that occupy more space. And in rework area the time to take rework is high. So unnecessarily it consume more space.

VIII. STEPS TAKEN TO IMPROVE FTT

7.1.1 Flux apply

The flux applied in the Controlled atmospheric brazing (CAB) on one side of the Header core's caps. We have identified this could be the problem for the rejection of W201 Heater core. So , We have tried to apply the flux on the both the sides of the cap. We have taken samples of 100 heater cores. Then we applied the flux on both the sides of the core. Then we checked the result of FTT. The FTT is only 72%.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

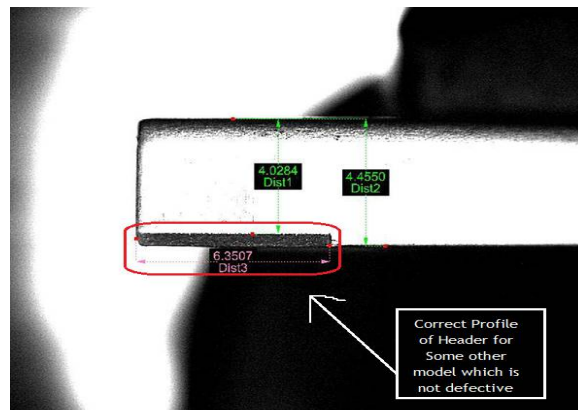


Fig 5:Correct profile of header viewed in rapid-I

In rapid-I machine header of heater is zoomed and viewed to check the shape of the profile. In other heater type which will produced vary minimum defect header is viewed,which so correct regular profile. And dimension also checked. That also as per dimension.

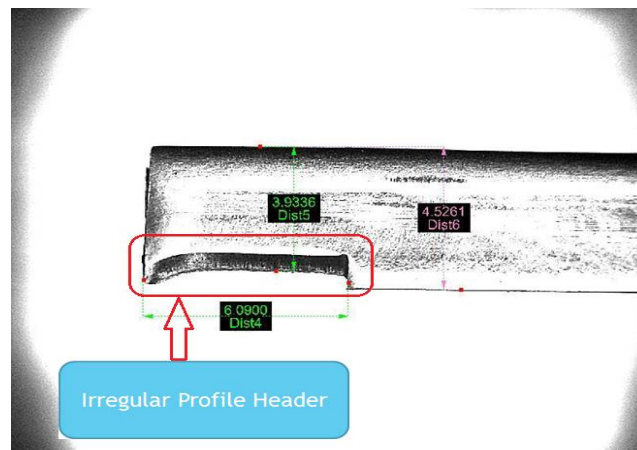


Fig6:Defect in Header find by Rapid-I

Above figures shows irregular profile of header of heater type W201. End of header must be straight but in this it shows some irregular profile this is due to press machine tool. So that it dimension varies 0.5mm from required dimension.

IX. SOLUTION APPROCHED

In the header producing press machine die is damaged. Due to this, header is not produced as per dimension in the ends. That is 0.5mm dimension varried. So if we want to change the die, then the modification is only carried out by the Korea R&D..Time to change die take approximately three months and cost to change the die is eighty lakhs. And also production will stop. So that we have another idea to change cap design corresponding to header improper dimension. Cap is bought in local area. That is near Ambatthur in chennai. Cap die can be changed with in one week and cost to change cap die is fifteen thousand rupees. So this will be good choice because of low cost and less time.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

The header tool in the press machine is very difficult to change. So, we modified the design of the cap. The header is varied 0.5mm from the required specification. So, we modified the cap design as reduction in 0.5mm in the side cutting. The following diagrams show the difference. The figure 7.1 shows as per the design given.

There is no problem from the design. But, the production of header varies from the actual design. A small gap is there in the production. This leads to increase in the scrap of the heater and reduction in the FTT.

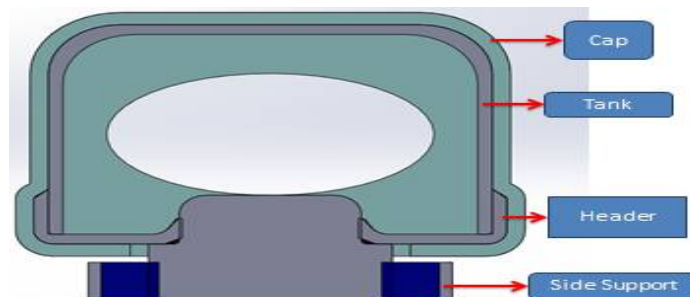


Fig 7: Heater as per design

Above diagram draw by solid work. This is assembled view of tank, header, side support and tank of heater type W201. That cut cross section is viewed. In this between header and cap there is no gap. So the dimension is correct.

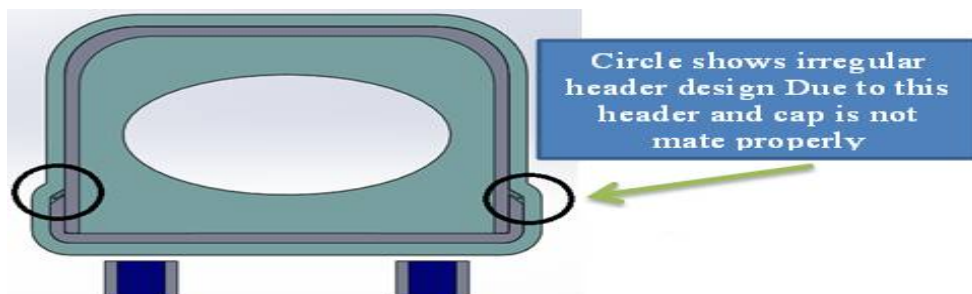


Fig 8: Heater (Before modification)

Above figures shows before modification design of heater type W201. In this between header and cap there is gap due to this gap leakage(defect) may happen. This gap due to improper header profile. Which is 0.5mm varies with required dimension.

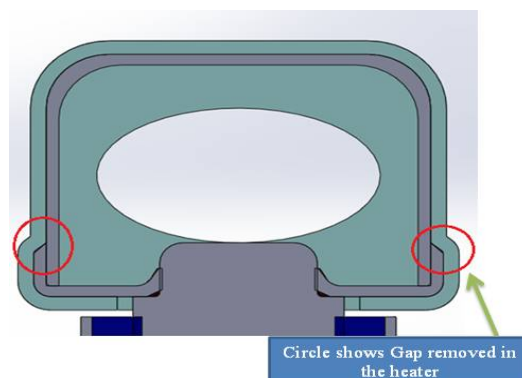


Fig 9: Heater (After modification)

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

Inorder to remove gap between header and cap, cap design is modified that is 0.5 mm cap dimension is modified to remove gap in heater type W201. That gap removed by cap shown by red circle in above figures. Dimesion of cap easily modified and dye also easily produced. But header tool change is difficult process. It requires more money and time to change the tool in press machine. Not only that production also stopped. So this is better idea.

8.1 COST ANALYSIS

Cost of one heater core =Rs498
 Average wastage (scrap) =30%
 Cost for 100 heater core =100*498
 =**Rs49800**
 For 100 Sample of heater core 30 was scrap.
 The cost for 30 cores =30*498
 =**Rs14940**

The cost for 100 heater cores is Rs.49800. But, the wastage (Scrap) cost is Rs14940.

8.1.1 After Our Modification

The average FTT after our modification =97.12%
 For 100 samples the number of wastages (Scrap) =3
 The cost for 3 wastages (Scrap) =3*498
 =Rs1494
 The cost of wastages before our modification =Rs14940
 The cost of wastages after our modification =Rs1494
 The cost saved for 100 samples =**Rs13446**

X. RESULT

The FTT of the W201 model before our modification is just around 70 %. When we modified the design, the FTT is about 97%

W201 PROOF LEAK TEST DURING FEBRAURY 2018																													
Description/Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total
Tested	0	0	0	0	0	179	239	87	291	234	125	0	310	360	386	197	0	0	0	60	408	186	71	0	0	0	0	0	3133
Ok	0	0	0	0	0	175	182	21	162	196	95	0	303	350	368	195	0	0	0	56	402	178	69	0	0	0	0	0	2752
Not Ok	0	0	0	0	0	4	57	66	129	38	30	0	7	10	18	2	0	0	0	4	6	8	2	0	0	0	0	0	381
Header Tube Leak	0	0	0	0	0	1	8	0	19	19	0	0	0	3	2	2	0	0	0	1	4	2	2	0	0	0	0	0	63
Minute Leak	0	0	0	0	0	3	15	9	40	8	6	0	2	1	4	0	0	0	0	2	0	5	0	0	0	0	0	0	95
Side Support	0	0	0	0	0	0	0	0	43	0	22	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	70
Open Cap Leak	0	0	0	0	0	0	29	33	15	5	1	0	1	1	2	0	0	0	0	1	2	1	0	0	0	0	0	0	91
Closed Cap Leak	0	0	0	0	0	0	10	24	15	0	1	0	2	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	57
TankLeak	0	0	0	0	0	0	0	0	0	0	0	0	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7

Table 3: W201 Proof Leak Testing During February 2017

After our modification in february 11in design of cap. Again data colleced and checked in february month. In that defects 381 out of 3133 parts. So if calculated out of 100 component nearly only 3 parts defects so which give 97.12% FTT(First Time through). Before our modification FTT is around 70% only. So we improved the FTT sucessfully.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

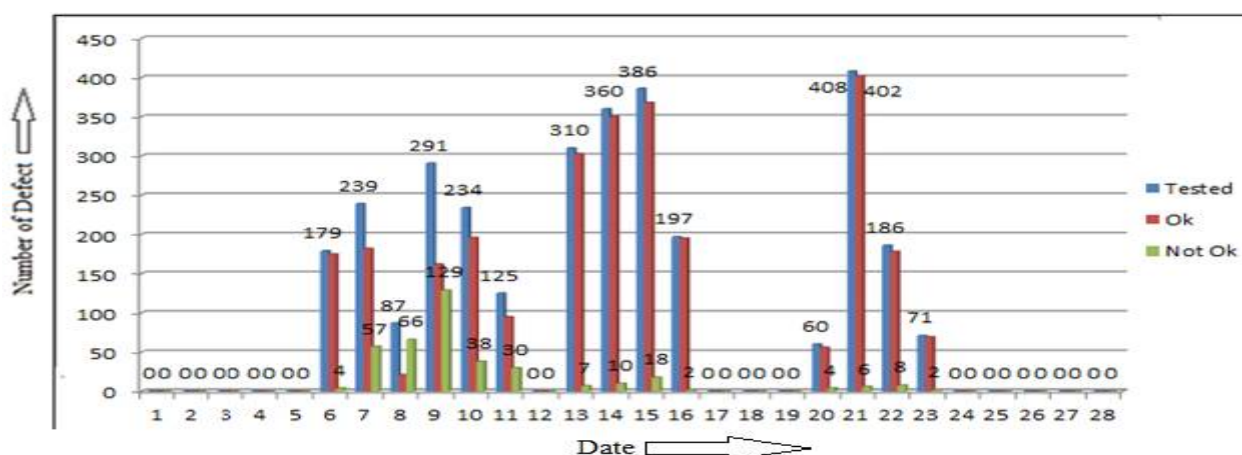


Fig 10: Defects and OK and Tested parts in February month

Above bar chart shows Ok, Not ok and tested parts number in February month. After our modification in February 11 Not ok parts (defects) reduced suddenly which can be seen in above figure. Not ok parts are mentioned in green color. From over data from February 11 to end of month FTT is 97.12%. This FTT is improved by changing design of cap.

REFERENCES

- [1] Amin, A.: Piezoresistivity in semiconducting positive temperature coefficient ceramics. *Journal of the American Ceramic Society* 72(3), 369–376 (1989).
- [2] Heywang, W.: Bariumtitanat als Sperrschicht halbleiter. *Solid-State Electronics* 3, 51–58 (1961)
- [3] Heywang, W.: Resistivity anomaly in doped barium titanate. *Journal of the American Ceramic Society* 47(10), 484–490 (1964).
- [4] Heywang, W.: Semiconducting barium titanate. *Journal of Materials Science* 6, 1214–1224 (1971)
- [5] Huybrechts, B., Ishizaki, H.: The positive temperature coefficient of resistivity in barium titanate. *Journal of Materials Science* 30, 2463–2474 (1995).
- [6] Jonker, G.H.: Some aspects of semiconducting barium titanate. *Solid-State Electronics* 7, 895–903 (1964)
- [7] Wang, D.Y.: Electrical properties of PTC barium titanate. *Journal of the American Ceramic Society* 73(3), 669–677 (1990)
- [8] Mamunya, Y.P., Muzychenko, Y.V.: PTC effect and structure of polymer composite. *Journal of Polymer Engineering and Science* 47, 34–42 (2007).
- [9] FLUENT Inc. *Fluent 6.3 User's Guide*; Centerra Resource Park 10 Cavendish Court Lebanon: Hanover, NH, USA, 2006.
- [10] Welty, R.J.; Wicks, C.E.; Wilson, R.E. *Fundamentals of Momentum, Heat and Mass Transfer*, 3rd ed.; John Wiley and Sons: New York, NY, USA, 1984.
- [11] Shin, Y.H.; Lim, D.H.; Kim, D.G.; Ahn, S.K.; Kim, K.Y.; Kim, S.C. Development of a PTC Elements and a Heater as Supplementary Heating for Internal Combustion Engine. In *Proceedings of the Fall Conference KSME 2013*, Jeongseon, Korea, pp. 3400–3403, 18–20 December 2013.
- [12] Gu, J.S.; Oh, K.H.; Jeong, S.H.; Wang, Y.H. A Study on Applying Hybrid PTC Heater to vehicle for Heating Performance Improvement. In *Proceedings of the Spring Conference KSAE 2016*, Jeju, Korea, pp. 762–767, 19–21 May 2016.
- [13] Lim, D.H.; Shin, Y.H.; Sim, S.K.; Song, J.W.; Ahn, S.K.; Kim, S.C. The Flow Analysis and Heating Performance Evaluation of PTC Heater for Electric Vehicles. In *Proceedings of the Fall Conference KSAE 2016*, Jeju, Korea, ; pp. 1234–1236, 19–21 May 2016.
- [14] Shin, Y.H.; Ahn, S.K.; Kim, S.C. Performance Characteristics of PTC Elements for an Electric Vehicle Heating System, 9, 813, *Energies* 2016.
- [15] Shin, Y.H.; Sim, S.K.; Kim, S.C. Performance Characteristics of a Modularized and Integrated PTC Heating System for an Electric Vehicle. 9, 18, *Energies* 2016.
- [16] American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 2009 ASHRAE Handbook—Fundamentals (SI Edition) Chapter 13–15, ASHRAE: Atlanta, GA, USA, 2009.