International Journal of Engineering Works
ISSN-p: 2521-2419
ISSN-e: 2409-2770
Vol. 6, Issue 10, PP. 387-391, October 2019
https://www.ijew.io/
https://doi.org/10.34259/ijew.19.610387391

Review of Remote Acting Fire Valve (RAF) Calibration and Rework Problems in Tesla Technology Private Limited Pakistan

Wiqas Alam[1] Zafar Ahmad[2]
NWFP, University of Engineering and Technology, Peshawar
wiqassuit17@gmail.com, engrzafar90@outlook.com
Received: 03 October, Revised: 08 October, Accepted: 11 October

***Abstract*—** The need for safety devices is increasing day by day in a fast-growing technology era. Many heating appliances involve oil fuel or liquefied petroleum gas burning in furnaces providing heat to the working facilities and our homes with controlled fires and careful management. The risk of blazing fire escaping from furnaces will cause potential harm and hazardous to our lives and damages to our houses. Remote acting fire valve (RAF) safeguard against the fuel being fed into the fire and prevent the total destruction by fire. The automated fire safety valve utilizes the temperature control sensor governed to minimize the risk of fire. The RAF with cut off temperature 66 ℃ or 90 ℃ depends on the model, the flow rate of 395 liters/hour with 2m head approved by BS5410. This paper demonstrates the operation, calibration, function, and Reworks of Remote Acting Fire valve (RAF), manufactured and assembled in Tesla Technologies Private limited Pakistan. RAF is a safety device designated to cut off fuels supply to heating appliances that may have malfunctioned. Failure and Reworks of RAF are the problems need to be resolved. The proposed solution to the rework problems at Tesla Private limited would be beneficial to the company and customers.

***Keywords*—** RAF, Calibration, Reworks, Aluminum die

I. INTRODUCTION

RAF is a fire-actuated device mounted on oil boiler providing safety against overheating, which may cause extreme harm to the oil boiler. The valve activate as the temperature exceeds the safe operating heating limit and allow the device to cool down to predetermined limit. Tesla Technology is Pakistan's largest manufacturing of CNG equipment's, RAF, electrical control devices. RAF composed of body, cover, bellow pipe, and brass rod, copper capillary, and rubber rings. The latch, adjuster, and knob are assembled with the body. A remote acting fire valve is a safety device designated to shut down the supply of oil fuel to heating appliances involving oil fuel burning or liquefied petroleum gas inside furnaces. The purpose of heating appliances to provide heat to working facilities and homes. The heat provided on the basis of controlled fire and careful management. The failure of the valve against explosions of the tanks of oil-filled boiler have been found to be the sensor's fault to compensate for the temperature and to follow constant Boyle's Law. The risk of blazing fire at our home can be potentially harmful and hazardous to our lives. Also, the failure of preventing fire escaped from furnaces cause damages to our house. Remote Acting Fire valve avoids such failure by providing a safe cut off from furnace supply to heating appliances. Unique mechanism followed by RAF to prevent fires from blazing above certain temperature range through temperature sensors.

The capillary sensors are exposed to the excessive heating, the firing valve closed tightly, preventing the main tank from fueling the fire. The temperature of the bulb increases, transmits heat through copper made capillary (excellent heat conductor), heat energy is sent to the bellow through the cap inside the bellow pipe. The bellow expands due to excessive heating and pushing the latch through the large gap for the rod to pass through. At first, the rod is fixed in the small gap of the latch shows the normal temperature and knob extended outwards. Knob extension is the 'ON' position and the latch has been pushed to allow the rod to pass through a large gap and moving the knob inwardly (the OFF position). The on and off position shows the normal and extreme temperature state inside the heating appliances. The capillary sensors are exposed to the excessive heating, the firing valve closes tightly, preventing the main tank from fueling the fire.

The sensor is mounted inside the insulating casing of boiler or furnace connected through capillary tube, a thin tube, to remotely fire valve. The valve installed in the fuel line supplies to the furnace. The liquid present inside the capillary tube expands as the heat exceed the expected level for the furnace. The expanded liquid cause the shutdown of the valve that turn off the fuel supply to the furnace. As a precaution once the valve close, it will not reopen unless manually reset standard set. The RAF is assembled, calibrated, and carefully tested in the facilities. Defects like crack, deformation and problems in the design are immediately rejected and placed in the specific component bin for correction and rework. The assembled remote acting fire valve is shown in Figure. 1

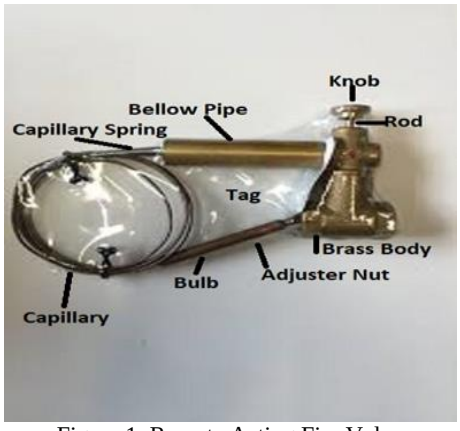

Figure 1. Remote Acting Fire Valve

II. LITERATURE REVIEW

A fire valve having a cooperating seat and shift able valve half. The valve half is carried by a floating valve stem. The primary valve includes a piston and cylinder combination that is operatively related to the valve stem and that causes the valve half to be by selection spaced from the valve seat in response to fluid pressure within the valve. A furnace destruction device at some point of which fireplace craving material was contained inside an exceeding reservoir, the reservoir having an outlet and inlet system containing number of nozzles that delivered fuels for fireplace to practical area. The device combines a valve between the reservoir outlet and the nozzle valve collectively with a movable valve. The valve member is movable from a closed function with relevance the valve seat stopping the exchange between the reservoir and nozzle to an open role permitting the flow of the fuels from the reservoir to the nozzle. The mechanism maintains a fluid pressured to closed position and is operable to vent the fluid to lower the strain inside the valve, so allowing the valve member to open. A coupling association joins the reservoir outlet to the valve stressed is carried out from the reservoir through the coupling member. This check valve prevents result the coupling device in an exceedingly reverse direction towards the mechanism proposed by Thompson et al.1977, Northill et al. 1993 [1, 2].

An activating device operated by a pressure medium, like compressed gas, acting at intervals will be secured to a valve by a mounting member hooked up to the valve. The activating device includes a primary piston radio-controlled during a cylinder half positioned on one surface of the valve and a toothed rack hooked up to the primary piston and meshed engagement with a pinion shaft. The pinion shaft is connected by a coupling half to the valve shaft, an equivalent activating device will be used for a bigger valve by putting a second piston in another cylinder half on the alternative facet of the primary piston with a toothed rack hooked up to the second piston and in meshed engagement with the pinion shaft. The primary and second pistons act in opposite directions and double the force working on the pinion shaft as compared to the force delivered by the primary piston observed by Hilpert and Hunziker et al. 1987 [3].

A method and system studied by Kelada et al. 2000 [4] for mechanically validate the pressure relief based operation valves for thee aggressive storage tanks, which may be remotely operated to protect discharge once disasters occur, permits the on-line substantiation of the escape practicality and correct operation. A method of activating a valve mechanism comprise injecting controlled fluid from a fluid reservoir of the valve mechanism system into a primary chamber of the valve mechanism, discharged controlled fluid from a second chamber into the fluid reservoir, and activating the valve mechanism from a primary position to a second position concluded by Lymberopoulos 2015 [5].

The fast-acting valve testing designed for blast generators (Blast/Thermal machine (LB/TS) by Eaton Consolidated Controls to be used in driver tubes, simulate decaying nuclear explosion's blast waves. The Eaton Throat Valve component (ETVE) was tested at the Idaho National Engineering Laboratory (INEL) to judge its performance against the planning criteria set by Stacey et al. 1992 [6].

A protection system for oil furnace consists of a pump that drives cylinder component with a double-acting piston movable through a rod to a suction piston component in the course of a suction element of the pump cylinder. The oil furnace is supplied with oil from a route having a shutoff valve or valves vicinity unit linked via a suction line to the suction phase of the piston. The suction component is linked through a check valve to the pressure cylinder that manage the motion of the power piston so it moves when the burner is turned off to displace the suction piston to impact a suction on the provision line to the oil of the burner consequently withdrawing the oil observed by Oppenberg et al. 1981 [7].

Morse et al. 1936 [8] worked on Safety valves; Equalizing valves, e.g. pressure relief valves motivated in consequence of extraneous circumstances, e.g. shock, modification of excessive temperature in the valve comprising liquefied, softening or soluble components, e.g. used as link, block part, seal, closure plug. Actuating devices; operative means; releasing devices motivated by fluid performing on a piston observed by Phillips et al. 1930 [9]. Systems for dominant combustion exploitation devices tuned in to thermal changes or to thermal growth of a medium studied by Smith et al. 1926 [10].. Burners within which liquid fuel evaporates within the combustion area, with or without chemical conversion of gaseous fuel examined by Grant et al. 1931[11].

Buchanan and Buchanan et al. 1992 [12] study on an accelerated mixture steam and heating oil provide and purge valve characteristic a steam valve and mechanism member that presents a closed position, a purge operation mounted between steam discharges lines ensuing in a furnace. In its closed position the oil provide to the recirculation valve member between the oil itinerary and a recirculation line that redirects oil to a tank or sort for reheating and for protection of the favored physique at some point of burner termination.

Kagi et al. 2006 [13] Presented invention related typical devices designed for the combustion of liquid fuels specifically to an improved methodology and equipment for burning high-viscosity and waste oil. The topic invention utilizes fuel transported from a distant supply fed oil regulator in conjunction with magnet valve set on the external burner assembly. The oil

yield preheating chamber contained at intervals a pre heater block. A constituent within the oil preheating chamber is dormant till the burner requires heat. Controlled air from a distant supply enters the burner assembly through regulator and air magnet valve then yield into a additive air tank. The controlled air is step by step free from the air preheating chamber at intervals the pre heater block, possessing a separate air constituent.

III. CALIBERATION OF REMOTE ACTING FIRE VALVE

RAF have to be calibrated before they can be used to provide safety to the oil boilers. The calibration of an instrument refers to the manner of marking-up a scale on the instrument to be used as intended function. Proper tag on threaded portion of the cover body is placed such that facing upward seen openly. RAF type depends upon the operating temperature, capillary length and the date (three digits signifying the year like 2019 as "9" and the two extreme digits for the week of the year e.g. "29"). According to the Table 1, tag would be assign accordingly to RAF.

Table 1. Remote Acting Fire Valve Tag codes at Tesla Private Limited.

Sr. No.	Tag Codes	Remote Acting Fire Valve
1	TVF66015	66 Degree × 1.5 m
2	TVF66030	66 Degree × 3 m
3	TVF66060	66 Degree × 6 m
4	TVF66090	66 Degree × 9 m
5	TVF66150	66 Degree × 15 m
6	TVF90015	90 Degree × 1.5 m
7	TVF90030	90 Degree × 3 m
8	TVF90060	90 Degree × 6 m
9	TVF90090	90 Degree × 9 m
10	TVF90150	90 Degree × 15 m

The following procedure to be followed to perform the calibration of RAF. Tank temperature adjustment depends on ambient temperature. Thermometer vertically hanging measure the room temperature. The RAF valve mostly fail due to the ambient conditions and incorrect reading of the temperature taken for calibrations. The calibration chart shown in table 2 give the required temperature depending on type and size of the RAF.

Table 2. Calibration Chart for RAF at Tesla Private Limited

Ambient temp℃>	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**
Model	**Size**							
66	**1.5**	77	72	68	63	58	54	49	45
	3	79	74	68	63	58	52	45	45
	6	78	73	68	63	58	53	48	45
	9	77	72	68	63	58	54	49	45
	15	82	76	69	63	57	50	45	45
90	**1.5**	95	94	92	90	87	84	81	79
	3	95	94	92	90	87	84	81	78
	6	95	94	92	90	86	83	79	75
	9	95	94	92	90	86	82	79	75

Tank temperature is set to the reading obtained from the calibration chart. But the reading must be 10℃ lower than the calibrated chart reading. The temperature reading attained for the calibration chart must be decodes into temperature range. Reaching the required value of temperature, bulb is placed inside the tank for 10 minutes and note the time using stop watch. After that, the adjuster nut rotated and adjusted at the point where the piece automatically turns to "off" position. Mark that point and lock threads there. Make sure that bulb is inside the oil tanker and motor works properly. Placing the RAF in the test bench properly and setting the temperature for specific type of RAF. The heat must evenly circulate by turning on the heater and fan. Temperature need to rise to the required set values. As the temperature reached, start stop watch and wait for an hour. Afterwards, the RAF in the "ON" position pass whereas the "OFF" RAF's are sent back for rework.

IV. REWORK OF REMOTE ACTING FIRE VALVE

The bellow pipe inserted inside the cover body with a spring attached to latch cover. A key inserted beneath the knob to allow slow and upwards push to the ON position while doing so latch is pushed with greater force inside the cover body. Make sure that knob is at OFF position. A problem at that phase lead to spring or latch changes. The failed pieces of RAF are sent back for reworks. Reworking include disassembles of remote acting fir valve, which is the real issue in Tesla Technology private limited. The workers in the RAF department use the heat gun to reopen or disassemble the RAF valve by hot air blow directly into the pieces. The remote acting fire valve capillary damages with excessive heating and cannot be rework. This issue damages the RAF capillary permanently, causing economic and customer losses.

Heat gun comprises a heating element and emits hot air stream at the temperature range between 100 C and 550 C. Variety of heat guns available depending on the temperature range and type of applications. Shrink heat, shrink tubing and shrink packing are the various application of heat guns. Hot air guns also known as hot air stations are used in rework mounted circuit board and De soldering of electronic circuits. The bellow pipes shown in Figure 2 tightly closed with capillary tubes of the remote acting fire valve.

Figure 2. The remote acting fire valve assemblies and bellow pipe.

The tightly fixed bellow pipe with brass body and capillary tubes make the rework difficult to proceed further. The heat gun with high temperature air blower damage the remote acting fire valve pieces. The U bend shape die is designed to hold the bellow pipes such that slow and steady heating of the pipe make the disassembly of RAF easy without damaging the piece. The proposed die made of Aluminum model and drawing is shown in Figure 3.

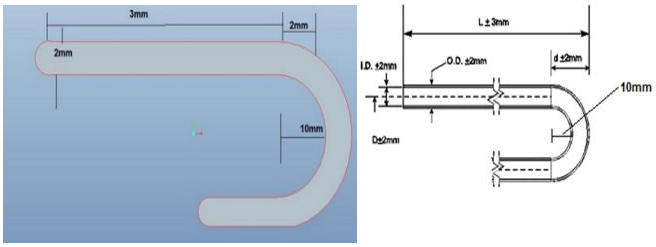

Figure. 3 The Pro e model and drawing of the aluminum made die for rework of RAF.

V. Performance Comparison

The remote acting fire valve rework performance comparison were made based on the average monthly production and theirs rework. The rework with heat gun for the disassembly of the valve has been investigate. The comparison were made for both cases shown in Figure 4. In the first case, the remote acting fire value reopened with direct blow of hot air stream blowing from heat gun and mostly the piece get damaged. The high heat directly flowing toward the capillary tubes bend the capillary permanently and the mobile oil filled within the capillary wasted. The damage pieces cannot be processed further. On the other hand the die made of aluminum in contact with bellow pipe and fitted in heat gun blower increase the temperature of aluminum die first and transmit heat to the bellow pipe steadily. The conduction mode of heat transfer safely open the RAF valve without damages. The monthly rework pieces damaged by heat gun with or without die were compared in order to compare the performance shown in Figure 4. The result clearly show the few pieces damaged with aluminum compared to the direct heating.

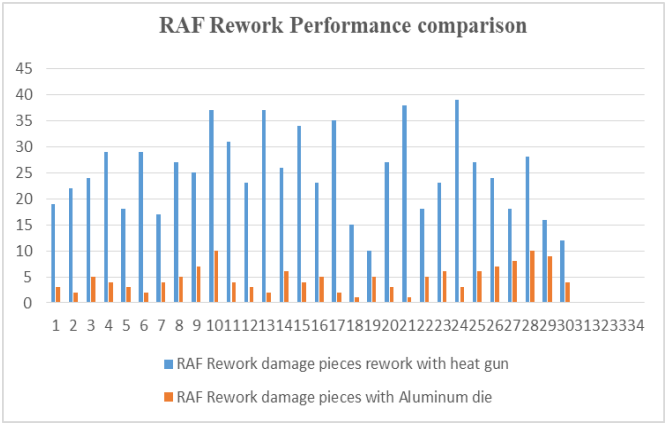

Figure 4. RAF rework performance comparison for both heat gun without die and with aluminum die.

Discussion

Tesla Technology private limited utilize heat gun for reopening of the failed pieces of RAF. The reopening involves the disassembly of the capillary tube, bellow pipes and other assembled parts. The continuous heat flowing through capillary, permanently damage the part. Die made of excellent thermal conductor materials grasp the tightly fitted bellow pipe and capillary. Turning on the heat gun and blowing the hot air through the die will slowly heat up the bellow pipe and capillary. Continuously checking with a key along with heating will make it easier for the bellow pipes to open without damaging the capillary. The accurate reading of ambient temperature at RAF small room inside the Tesla Technologies will prevent the valve's failure. Environmental changes greatly affect the temperature inside the company rooms and also, the calibration chart changes with it. The RAF limits changed during calibration which lead to the failure of the most valves. Isolating the calibration room from external environment will give positive impact on RAF valves. The valve opening for reworks comparison between direct heat gun without die and with the die were done. The aluminum give satisfactory result for the opening valve of the remote acting fire valve.

Conclusions

Tesla Technologies private limited company formed in 1992 providing services of design and produce hi-tech refined and reliable equipment, control and safety instruments for local and engineering uses at reasonable costs. Remote acting fire vale being exported generate a substantial amount of foreign exchange. The two main issue regarding RAF assemblies, calibration and reworks arises are the poor performance due to inaccurate measurement of ambient temperature and disassembly of the RAF. Excellent thermal conductive material die could resolve the issue without damaging the remote acting fire valve. The bellow pipe and capillary separation can be easily done with the help of continuously slow heating the die, otherwise, consequences are that more than half work pieces of remote acting fire valve would fail. The aluminum die gives satisfactory result regarding the opening of the failed pieces for

rework. Tesla Technologies need to gear up the productivity by resolving such critical problems.

REFERENCES

[1] Thompson, W. S. (1977). Pressure reducing fire valve, Google Patents.

[2] Northill, B. W. (1993). Fire suppression systems, Google Patents.

[3] Hilpert, B. and B. Hunziker (1987). Remote control actuating device for a valve, Google Patents.

[4] Kelada, M. I. (2000). Remote function verification of low pressure and vacuum relief devices, Google Patents.

[5] Lymberopoulos, D. (2015). Valve actuator control system and method of use, Google Patents.

[6] Stacey, M. R. (1992). Performance Tests of a Fast-acting Valve for the Driver Tubes of a Large Blast/Thermal Simulator, EG AND G IDAHO INC IDAHO FALLS.

[7] Oppenberg, R. (1981). Safety device for an oil burner, Google Patents

[8] Morse, L. H. (1936). Valve, Google Patents.

[9] Phillips, S. C. (1930). Steam-operated emergency valve for oil and gas wells, Google Patents.

[10] Smith, I. E. (1926). Oil-burner-control system, Google Patents.

[11] Grant, W. S. (1931). Oil burner, Google Patents.

[12] Buchanan, B. F. and J. R. Buchanan (1992). Combination steam and fuel oil supply and purge valve with recirculation feature, Google Patents.

[13] Kagi, T. (2006). Waste oil multi-fuel fired burner, Google Patents.

Engr. Wiqas Alam
DOB: 1st, Sept, 1990, Karak, KPK
Master in Material Engineering, University of Engineering and Technology, Peshawar.