# Thermo-Mechanical Performance of Cold Weld Metallic Paste with Epoxy Additives

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## *Abstract*

*In many fluid flow component manufacturing industries, leakage of the flow fluid within the system is one of the major defects so that the system performance will come down. This leakage within the system is because of material composition variation, heterogeneous mixture of the chemical composition and manufacturing defect. Also the leakages of the manufactured part occur due to crack or blow holes formation during welding operation. In order to maintain the even performance, it is required to avoid the leakage due to crack or blow holes formation by cold weld operation with cold weld metallic paste. The cold weld metallic paste is like a paste made from iron with few compositions. This cold weld process avoids heating effect thereby no sudden heating or cooling of the part under leakage. During this cold welding with the help of metallic paste, the prepared paste needs to be paste over the crack or blow holes where the leakage is present on the manufactured part. This metallic paste is able to withstand continuous heat up to 1300°C. With this high thermal resistance, it can be used over exhaust pipe lines, engine cylinder/combustion chamber surface, heat exchangers, boilers, mufflers etc.*

***Keywords:*** *Cold weld metallic paste, Leak proof weld, Heat resistance weld, Cold weld epoxy additives.*

## I. INTRODUCTION

J-B Weld is a two-segment epoxy paste that can withstand high-temperature conditions. J-B Weld can be used to security surfaces developed utilizing metal, porcelain, pottery, glass, marble, poly vinyl chloride, ABS, fiberglass, wood and paper [1]. Alcohol should be kept up a key good ways from when cleaning surfaces, as it can degenerate the bond [2]. J-B Weld is waterproof, oil/substance safe when cemented, and destructive safe. It moreover contradicts stagger, vibration, and uncommon temperature variations. J-B Weld can withstand a relentless temperature of 270°C, and the most outrageous temperature edge is around 320°C for 10 minutes. Condensation of oxides of epoxy resins and amines was first developed and patented by Paul Schlack [4]. Claims of discovery of bi-phenol A-based epoxy resins include Pierre Castan where work was licensed by Ciba which went on to become one of the three major epoxy resin developers worldwide [5]. J-B Weld can similarly be used inside a microwave, introduced to microwave radiation instead of infrared radiation heat transfer [7]. The thing is contained in two separate chambers: the ‘hardener’ and the ‘steel’. Proportionate wholes are crushed from the two tubes and mixed. For the best weld, surfaces brought to be roughened with fine or coarse sandpaper.

The mix will set up, for dealing with, inside 4–6 hours, anyway requires 15 hours (at cool temperatures) to totally fix and harden. Right when initially mixed, J-B Weld is subject to hanging or running (slow spilling), even more so at more sultry temperatures. After around 20

minutes the mix begins to thicken into putty that can be shaped, which ends up being hard after 4–6 hours. At low temperatures in few hours, the putty can be framed into a weld globule or ousted shape [7]. J-B Weld works speedier when used in more than 520 °C. After J-B Weld has re-established for the underlying six hours, a glow light or brilliant light put near the weld will speed the easing time. An application may hang or spill before 6 hours.

J-B Weld can be used as a paste, spread, plug, additive, sealant/gum, or electrical insulator. When totally alleviated, J-B Weld can be infiltrated, encircled, ground, tapped, machined, sanded, and painted. However, until hardened, it can hang or stream when applied [8].

J-B Kwik is a two-area epoxy paste that can withstand medium-temperature circumstances. It fixes significantly more quickly, yet it isn't as strong or as warmth protected as the main J-B Weld. However, J-B Kwik has a comparative grasp as J-B Weld, and moreover doesn't contract when hardening. J-B Kwik can be used to bond surfaces produced using any blend of iron, steel, copper, aluminum, metal, bronze, pewter, in addition to porcelain, wood, fired, glass, marble, poly vinyl chloride, ABS, solid, fiberglass, texture, or paper[10]. J-B Kwik is waterproof, oil/synthetic safe (when relieved), corrosive safe; in addition to opposes stun, vibration, and extraordinary temperature fluctuations.

The JB weld expoxy paste was used to arrest the blow holes produced by welding the sleeves on a cylinder head of an engine for mounting thermocouples. The blow holes occur due to welding of CI material with steel and the same leak was arrest using this paste [27] [28].

## II PROPERTIES OF EPOXY MATERIALS

At the point when at least two articles need to cling to one another for an all-inclusive time, the most ideal approach to achieve that is with epoxy. The application bundle accompanies two syringes containing segments that respond together to frame a solid, enduring bond. Because of the qualities epoxy has, organizations and people use epoxy for a wide scope of uses.

Epoxy application packs have a long time span of usability. Rediscovered epoxy syringes have be found, following quite a while of being overlooked, that fill in just as epoxy purchased the day of utilization.

### *2.1PROPERTIES OF EPOXY*

The essential explanation behind epoxy's notoriety is its magnificent mechanical quality. Welding is regularly the main other option. Epoxy is almost constantly less expensive and quicker than welding.

Epoxy likewise has magnificent protection from synthetic concoctions. In the wake of setting, there is no stress of a synthetic response that will debilitate the seal. It additionally opposes heat. That obstruction makes it perfect for hardware and electrical frameworks and other modern applications.

The individuals who use epoxy know about the magnificent mechanical quality and low relieving constriction. They likewise know the epoxy saps are well-adjusted mechanical materials and fit to a wide scope of utilizations.

Architects are looked with worries about warmth dissemination, electrical protection, following divergent substrates, light weighting, sound hosing, vibration, and decrease erosion. Appearance must be considered, just as, amassing costs. Epoxy is a cement definition that meets those worries. Its warm and electrical properties, quality, and sturdiness are what epoxy is noted for. Those properties alongside the protection from inundation and unfriendly concoction fume are the explanation epoxy regularly is picked by engineers.

*2.2 PERFORMANCE PROPERTIES*

Execution properties held by epoxy are:
- Biocompatibility
- Environmentally well disposed
- Flame safe
- Food Safe

It has magnificent hole filling properties. Epoxy is impervious to cold, radiation, and steam. The predominant exhibition of epoxy remains when presented to unfriendly natural conditions.

Epoxy is either any of the essential parts or the restored final results of epoxy saps, just as a conversational name for the epoxide useful group [1]. Epoxy gums, otherwise called polyepoxides, are a class of responsive prepolymers and polymers which contain epoxide gatherings.

Epoxy tars might be responded or cross-connected either with themselves through synergist homo-polymerization, or with a wide scope of co-reactants including poly-functional amines, acids, corrosive anhydrides, phenols, alcohols and mercaptans. These co-reactants are frequently alluded to as hardeners or curatives, and the cross-connecting response is usually alluded to as restoring.

Reaction of poly-epoxides with their mixtures or with poly-functional hardeners results in thermosetting polymer, often with favorable mechanical properties and high heat and chemical resistance. Epoxy has a broad range of applications, including metal coatings, use in electronics/electrical components, high tension electrical insulators, brush manufacturing, fiber-reinforced plastic materials and structural adhesives. Epoxy is also used as glue.

Epoxy resins are characterized by their very good electrical properties and chemical resistance, good strength and low absorption of moisture. They are versatile resins, contributing particularly excellent resistance to corrosion solvents, alkalis and some acids, high strength to weight ratio, dimensional stability and adhesion properties. They are straight chain polymers formed by condensing epi-chloro-hydrin with biphenyl A. Other formulations are glycidyl esters for vacuum impregnation, lamination and casting, glycidyl ethers of novolac and brominated resins. They differ from polyesters and vinyl esters in that they do not include any volatile monomer component. Different resins are produced by varying the ratios of the components.

The resins are normally high in viscosity, so that they are molded at temperatures in the region of 48-110°C, or dissolved in an inert solvent to reduce its viscosity to a point at which lamination at room temperature becomes possible. Curing agents, also referred to as catalytic converters, hardeners are used, acting either by catalytic conversion or directly reacting with the resins.

With correct additives, epoxy resins can exhibit outstanding resistance to heat and electrical insulation properties. They may be either in liquid or solid form and can be formulated to cure either at room temperature of with the aid of heat. Heat curing is more common for situations where maximum performance is required. Epoxies cure more slowly than other thermo set resins. Cold-cure types are available, but performance is usually better when curing at 40-60°C. Epoxies are frequently used in aerospace and defense, chemical plant and high performance automotive applications.

## III. EXPERIMENTAL WORK

### *3.1 J-B WELD EXTREME HEAT*

J-B Cold Weld Extreme Heat is defined to take into consideration fixes to iron, steel and metal in high temperature conditions up to 1300˚C. When completely restored, this metallic compound can be bored, machined or sanded. It is extraordinary for fixing breaks, little holes, crease associations or gaps in ventilation systems, pipe associations, suppressors, exhaust systems, open air flame broils, fire boxes, gas and business heaters and water warmers. This item is water based non-combustible and contains no solvents or Volatile Organic Compounds.

### *3.2 APPLICATIONS*

- Exhaust Pipe lines
- Tail Pipes
- Silencer manifolds
- Engine components
- Combustion Chamber
- Heat Exchanges
- Fire Box
- Outdoor structures


**Fig. 3.1 Special features of J-B weld extreme heat**

### *3.3 ADDITIVES*

The epoxy resins selected for additives with JB weld metallic paste to improve the structural strength of metallic paste along with thermal strength. The additive – epoxy resins used are:

1. LY556
2. B-6000 UV
3. Carbon Block Epoxy Laminating Resin
4. Hardener HY951

The 6 different combination samples of paste-test specimens were prepared with base material\paste as shown in Fig.3.2. The prepared samples were finally crushed/compressed with hand pressing machine and allowed for further dry.

**a). LY556 and Carbon Block Epoxy Laminating Resin**

**b). B-6000 UV and Carbon Block Epoxy Laminating Resin**

**c). LY556 and B-6000 UV**

**d). LY556, Carbon Block Epoxy Laminating Resin and Hardener**

**e). B-6000 UV, Carbon Block Epoxy Laminating Resin and Hardener**

**f). LY556, B-6000 UV and Hardener**

**Fig. 3.2 Combination samples of cold weld metallic paste**

Tests were conducted for structural and thermal properties such as hardness and thermal property (melting point) using Brinell hardness tester and closed furnace respectively, and the test results were tabulated shown in Tables 3.1 and 3.2.

**Table 3.1: Structural and Thermal testing of JB weld metallic paste**

| Test Specimen | Structural Property (Hardness in gm) | Thermal Property (Melting Point in $^{o}$C) |
|---|---|---|
| JB weld metallic paste | 19 | 1300 |

**Table 3.2: Structural and Thermal testing of JB weld metallic paste with additives**

| ADDITIVES with JB Weld Metallic Paste | Structural Property (Hardness in gm) | Thermal Property (Melting Point in $^{o}$C) |
|---|---|---|
| LY556 and Carbon Block Epoxy Laminating Resin | 30.25 | 890 |
| B-6000 UV and Carbon Block Epoxy Laminating Resin | 25.30 | 780 |
| LY556 and B-6000 UV | 26.22 | 720 |
| LY556, Carbon Block Epoxy Laminating Resin and Hardener | 28.85 | 750 |
| B-6000 UV, Carbon Block Epoxy Laminating Resin and Hardener | 24.22 | 710 |
| LY556, B-6000 UV and Hardener | **32.12** | **985** |

## IV. RESULTS & DISCUSSION

The graphs were drawn for Structural Property and Thermal Property with JB weld Metallic Paste and Additives (6 different samples of paste) as shown in Fig. 4.1 and 4.2.

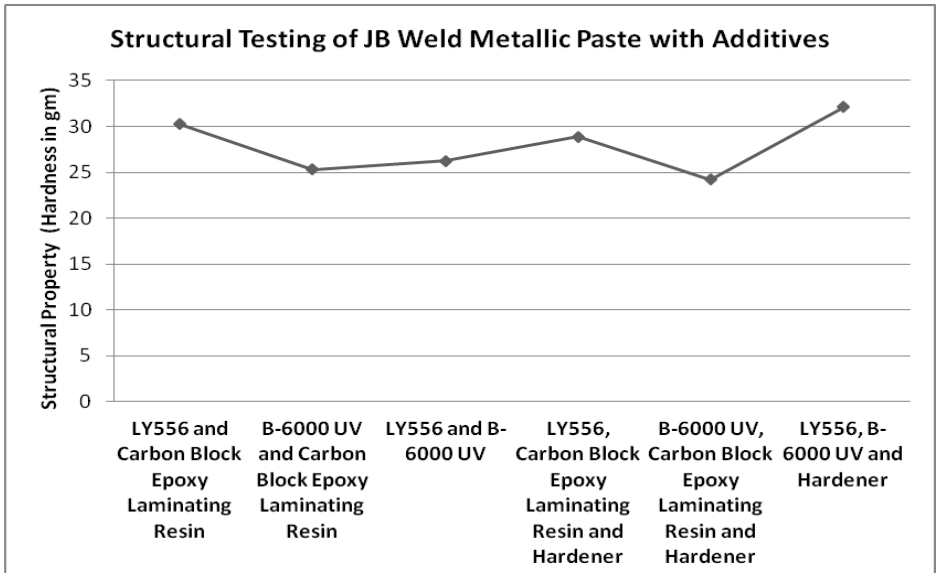


**Fig. 4.1 Structural Property v/s JB weld Metallic Paste and Additives**

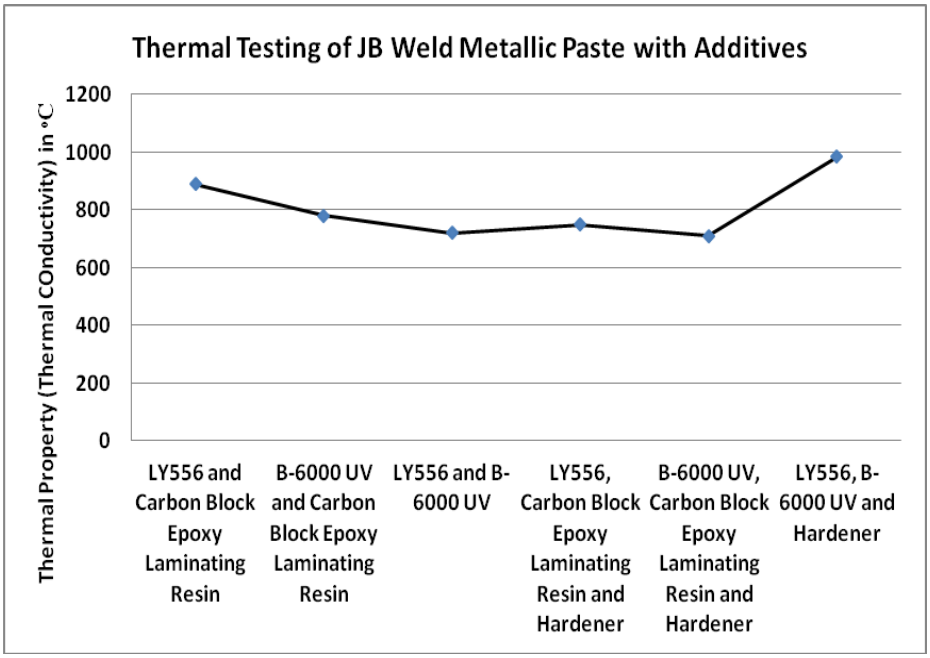


**Fig. 4.2 Thermal Property v/s JB weld Metallic Paste and Additives**

It is observed from the graphs of Structural and Thermal Properties with JB Weld Metallic Paste and additives, the sample LY556, B-6000 UV and Hardener provides higher hardness and thermal conductivity.

## V. CONCLUSION

JB Weld Metallic Paste is utilized for filling the cracks and blow holes on the metallic surfaces subjected to high temperature ranges up to 1300 °C. From the above results, the sample LY556, B-6000 UV and Hardener with higher hardness and higher melting point is utilized for cold weld applications.

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