केवल कार्यालयीन उपयोग हेतु
For Official Use Only

भारत सरकार - GOVERNMENT OF INDIA
रेल मंत्रालय - MINISTRY OF RAILWAYS

इपॉक्सी रेजिन - संरचनाओं की मरम्मत में इसका उपयोग - फरवरी 2014 -1st संशोधन

Epoxy Resin – Its Application In Structural Repairs - Feb' 2014 – 1st Revision

केमटेक/2020/सि/इपॉक्सी रेजिन-1st संशोधन /1.0
CAMTECH/2020/C/EPOXY RESIN – 1st Rev/1.0
अक्तूबर - 2020
October – 2020

अग्रदूत RDS
रेल अग्रदूत Transforming Railways

An ISO 9001:2015 Certified Organisation
उच्च अनुरक्षण प्रौद्योगिकी केन्द्र
EXCELLENCE IN MAINTENANCE

Indian Railways
Centre for Advanced Maintenance Technology

महाराजपुर, ग्वालियर - 474005 (भारत)
Maharajpur, Gwalior - 474 005 (INDIA)
✆ : 0751 - 2470869 & Fax : 0751 - 2470841

इपॉक्सी रेजिन -
संरचनाओं की मरम्मत में इसका उपयोग - फरवरी 2014
-1st संशोधन

Epoxy Resin –
Its Application In Structural Repairs - Feb' 2014
– 1st Revision

Foreword

Epoxy resin is a chemical product which is extensively used for various applications such as grouting of cracks, repair of eroded concrete structures, emergency repairs of bridges, protective coatings, etc.

Structures may show distress during its service life due to faulty design, improper execution, bad workmanship, lack of maintenance, and other factors such as extreme weathering and environment conditions. As a result, the structure becomes unstable and requires maintenance in due course. Structural stability of such structures may be ensured through application of Epoxy resins.

The booklet prepared by CAMTECH is informative in context of providing basics of epoxy resin in various forms and its structural applications and also including manufacturers' products details.

It is expected that this booklet will be quite helpful to those who are engaged in maintenance and construction of Civil Engineering Structures in Indian Railways.

CAMTECH/Gwalior ***(Jitendra Singh)***
Date ..... October, 2020 ***Principal Executive Director***

Preface
(1st Revision)

Epoxy resin as first commercialized in 1946 is one of the most important and widely used polymeric system that includes paints and coatings, adhesives, sealants, fillers, reinforced polymer composites and varnishes. Epoxy resins are of particular interest to structural engineers because they provide a unique balance of chemical and mechanical properties combined with extreme processing versatility.

In civil engineering works, the epoxy resin system find application in grouting of cracks, repairs of eroded concrete structures, emergency repairs of bridges, aqueducts, chemically corroded columns and beams, etc.

CAMTECH has first published a booklet on "Epoxy Resin – Its Application in Structural Repairs" in 2013-14. The same is revised in context to include latest information as available on Epoxy materials used for structural repairs of civil engineering structures. The product details including their manufacturing firms are also covered in the revised booklet.

The booklet is prepared with the objective to disseminate knowledge to the concerned who are engaged in construction and maintenance of civil engineering structures over the Indian Railways.

The revised booklet is not statutory and contents are only for the purpose of guidance. Most of the data & information mentioned herein are available in some form or the other in various books and other printed matter and at Internet. The manufacturers' websites are referred for product details as compiled in the chart (annexure-1). For more in-depth information, the relevant codes and reports on the subject may be referred before final implementation of any technique/ or method described in this booklet.

We welcome any suggestions from readers for further improvement.

CAMTECH/Gwalior ***(D.K. Gupta)***
Date 27th October, 2020 ***Director/Civil***

प्राक्कथन

प्रायः समस्त सिविल इंजीनियरिंग संरचनाओं को संरचनात्मक स्थिरता एवं स्थायित्व हेतु पुनर्वास की आवश्यकता होती है। स्थायी एवं विश्वसनीय मरम्मत के लिए सबसे अधिक आवश्यक कार्य होता है मरम्मत सामग्री का चुनाव करना। इपॉक्सी रेजिन, एक महत्वपूर्ण तथा व्यापक रूप में उपयोग किया जाने वाला पॉलीमरिक सिस्टम है जो कि पेंट्स एवं कोटिंग्स, एडहेसिव्हस, सीलेंट्स, इत्यादि में प्रयुक्त होता है।

केमटेक द्वारा तैयार की गई इस लघुपुस्तिका में विभिन्न उपयोगों को जिनमें इपॉक्सी रेजिन सामग्री का प्रयोग होता है, को समाविष्ट किया गया है।

यह उम्मीद की जाती है कि भारतीय रेल के समस्त सिविल इंजीनियरिंग स्टाफ के लिए यह पुस्तिका निश्चित रूप से उपयोगी सिद्ध होगी।

केमटेक, ग्वालियर ***(ए. आर. तुपे)***
दिनांक 25, फरवरी 2014 ***कार्यकारी निदेशक***

Foreword

Almost all civil engineering structures need rehabilitation in terms of structural stability and durability. The most important task for ensuring durable and trust worthy repair is the selection of repair material. The Epoxy Resin is one of the most important and widely used polymeric system, which includes paints and coatings, adhesives, sealants, etc.

The booklet prepared by CAMTECH incorporates various applications in which epoxy resin material is used.

It is expected that this booklet will be quite helpful to civil engineering personnel of Indian Railways engaged in this activity.

CAMTECH/GWALIOR ***A. R. Tupe***
DATE: 25, February 2014 ***Executive Director***

भूमिका

एक बड़ा संगठन होने के नाते भारतीय रेल के पास इंजीनियरिंग संरचनाओं एवं भवनों की विशाल संपदा मौजूद है। अधिक पुराने होने के कारण इन संरचनाओं में विकृति के चिन्ह दिखाई देते हैं जिस कारण इंका रखरखाव आवश्यक हो जाता है। 1946 से लगातार रसायनयुक्त सामग्री इपॉक्सी रेजिन का उपयोग सिविल इंजीनियरिंग कार्यों जैसे कि दरारों की भराई, कटानयुक्त कंक्रीट संरचनाओं की मरम्मत, पुलों की आपात मरम्मत, कृत्रिम जलाशय, रासायनिक रूप से क्षययुक्त कॉलमों एवं बीमों में किया जा रहा है। इपॉक्सी रेजिन आकस्मिक मरम्मतों तथा संरचनात्मक पुनर्वास हेतु आदर्श सामग्री है।

'इपॉक्सी रेजिन-संरचनाओं की मरम्मत में इसका उपयोग' पर इस लघुपुस्तिका को तैयार करने का उद्देश्य रखरखाव कार्यों में लगे सिविल इंजीनियरिंग स्टाफ के मार्गदर्शन के लिए तकनीकी जानकारी उपलब्ध कराना है।

यह लघुपुस्तिका वैधानिक नहीं है तथा इसमें दी गई जानकारी का उद्देश्य केवल मार्गदर्शन है। किसी न किसी रूप में अधिकांश डेटा एवं जानकारी, साहित्य सर्वेक्षण तथा इंटरनेट खोज पर आधारित है। अधिक जानकारी के लिये, इस पुस्तिका में निहित किसी भी जानकारी को अंतिम रूप से लागू करने से पहले विषय पर उपलब्ध प्रासंगिक साहित्य का अध्ययन संदर्भ रूप में किया जाना चाहिए।

इस पुस्तिका के सुधार हेतु पाठकों के किसी भी सुझाव का हम स्वागत करते हैं।

केमटेक, ग्वालियर ***(एस. के. सक्सेना)***

दिनांक 24, फरवरी 2014 ***उप निदेशक/ सिविल***

Preface

Indian Railways is a big organisation having large assets of civil engineering structures and buildings. These structures due to ageing show signs of deterioration and require maintenance. The chemically blended materials such as epoxy resins are in use since 1946 and find application in civil engineering works such as grouting of cracks, repairs of eroded concrete structures, emergency repairs of bridges, aqueducts, chemically corroded columns and beams. Epoxy resins are ideal for emergency repairs and structural rehabilitation.

This booklet is prepared with the objective to provide informative technical details on *'Epoxy Resin – Its application in Structural Repairs'* for the guidance of civil engineering staff involved in maintenance work.

This booklet is not statutory and contents are only for the purpose of guidance. Most of the data & information mentioned herein are available in some form or the other in various books and other printed matter and at Internet. For more in-depth information, the relevant codes and reports on the subject may be referred before final implementation of any technique/ or method described in this booklet.

We welcome any suggestions from readers for further improvement.

CAMTECH/GWALIOR ***S. K. Saxena***
DATE: 24, February 2014 ***Dy. Director/Civil***

विषय - सूची / CONTENTS

स. क्र./ S. No.	विवरण / Description	पृ. सं. / Page No.
	Preface (1st Revision)	
	प्राक्कथन / *Forward*	***i***
	भूमिका / *Preface*	***ii***
	विषय-सूची / *Contents*	***iii***
	संशोधन पर्ची / *Correction Slip*	***iv***
1.0	परिचय/Introduction	***1***
2.0	संरचनात्मक मरम्मत की आवश्यकता/Need of Structural Repairs	***4***
3.0	इपॉक्सी रेजिन/Epoxy Resin	***4***
4.0	इपॉक्सी क्यूरेटिव्स/Epoxy Curatives	***7***
5.0	इपॉक्सी मॉडीफायर्स/Epoxy Modifiers	***9***
6.0	इपॉक्सी रेजिन सिस्टम्स/Epoxy Resin Systems	***11***
7.0	खॉचादार पीआरसी स्लीपरों का इपॉक्सी आधारित उपचार/Epoxy Based Treatment of Grooved PRC Sleepers	***12***
8.0	संरचनाओं में दरारों की इपॉक्सी आधारित इंजेक्शन ग्रॉटिंग/ Epoxy Based Injection Grouting of Cracks in Structures	***14***
9.0	पुरानी कंक्रीट का नई कंक्रीट के साथ इपॉक्सी आधारित जोड़/Epoxy Based Bonding of Old to New Concrete	***16***
10.0	इपॉक्सी आधारित संक्षारक विरोधी बचाव रुपी परतें/EPOXY Based Anti Corrosive Protective Coatings	***16***
11.0	इपॉक्सी आधारित अन्य उपयोग/Epoxy Based Other Applications	***20***
12.0	अपनाई जाने वाली सावधानियॉ/Precautions to be Taken	***21***
13.0	व्यापारिक रुप से उपलब्ध इपॉक्सी आधारित उत्पादित वस्तुऐं/Commercially Available Epoxy Based Products	***22***
14.0	**निर्माण उद्योग में इपॉक्सी रेजिन के मुख्य अनुप्रयोग/** Main Application of Epoxy Resin in the Construction Industry	***35***
15.0	**क्यों इपॉक्सी विफल हो जाता है - कारण और उपाय/** Why Epoxy gets failed – Causes & Remedy	36
Annexure-1	Chart Showing Details of some of Manufacturing firms & their Products	38
	References	***65***
	Notes	***66***
	Quality Policy and Disclaimer	***67***

संशोधन पर्चियों का प्रकाशन

इस लघुपुस्तिका के लिए भविष्य में प्रकाशित होने वाली संशोधन पर्चियों को निम्नानुसार संख्यांकित किया जाएगा :

केमटेक/2020/सि/इपॉक्सी रेजिन-1st संशोधन /1.0 सीएस#XX दिनांक ----------

जहाँ XX संबन्धित संशोधन पर्ची की क्रम संख्या है (01 से प्रारम्भ होकर आगे की ओर)

प्रकाशित संशोधन पर्चियाँ

क्र.सं.	प्रकाशन दिनांक	संशोधित पृष्ठ संख्या तथा मद संख्या	टिप्पणी

ISSUE OF CORRECTION SLIPS

The correction slips to be issued in future for this handbook will be numbered as follows:

CAMTECH/2020/C/EPOXY RESIN-1st Rev/1.0/CS. # XX date .....

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

CORRECTION SLIPS ISSUED

S. No.	Date of issue	Page no. and Item No. modified	Remarks

1.0 परिचय / INTRODUCTION

Resin is a solid or highly viscous substance of plant or synthetic origin that is typically convertible into polymers. Synthetic resins are industrially produced resins, typically viscous substances that convert into rigid polymers by the process of curing.

There are two major groups of resins – common thermosets that include polyester, epoxy, vinyl ester and polyurethane, and thermoplastics that include ABS (Acrylonitrile Butadiene Styrene), polyethylene, polystyrene, and polycarbonate. Thermoplastic and thermoset, both are opposite in terms to the way the material responds to heat. Thermoplastic can be heated to their melting point, cooled, and re-heated again without significant degradation, while thermoset plastics can only be heated once and a second time, it would simply burn at high temperature. For thermoset plastics that require only one monomer known as "resin", which takes longer for resin glues to cure, usually around eight to ten hours.

Synthetic resins such as epoxy, polyester, acrylic, polyurethane and similar resins have found application in civil engineering. Epoxy resins, which were first commercialized in 1946, are one of the most important and widely used types of polymeric systems that include paints and coatings, adhesives, sealants, fillers, reinforced polymer composites and varnishes. These epoxy resin system find application in civil engineering works such as grouting of cracks, repairs of eroded concrete structures, emergency repairs of bridges, aqueducts, chemically corroded columns and beams. To support these applications, epoxy resins are formulated to generate specific physical and mechanical properties.

Epoxy resins are of particular interest to structural engineers because they provide a unique balance of chemical and mechanical properties combined with extreme processing versatility. They possess very high mechanical and adhesive strength properties most desirable for many civil engineering applications (structural and specialty composite applications) including

curing under wet conditions. They are ideal for emergency repairs and structural rehabilitation.

The use of epoxy resin for industrial floor topping is characterized by its exceptional physical and chemical properties, such as chemical resistance, hardness, abrasion resistance, compressive, impact and flexural strengths, negligible shrinkage, dimensional stability and adhesion to cured concrete, metals and other surfaces.

As the mechanical and the chemical properties of the epoxy resin floor topping mix depend on the composition of the mix, it is essential that the formulator should be consulted for details concerning the material.

The three basic elements of an epoxy resin formulation when selecting a thermoset system are the base resin, curatives, and the modifiers. It is generally agreed, that cured resin formulations suitable for elevated temperature applications are largely determined by cross-linking density. It is important to remember that the molecular structure and other characteristics of the cured product are equally dependent on the base resin, the curing agent, and modifiers employed in the formulation.

Epoxy resins when cured with different hardeners offer wide range of properties. Once cured, they form irreversible system (thermosetting). The system is gaining wide popularity due to varied properties in cured composition, like high chemical resistance against acid, alkali, solvents and fertilizers; less abrasion and low shrinkage; high compressive, flexural and tensile strength; high bonding strength with dissimilar materials, etc.

The properties of epoxy resin can be modified to satisfy the most varied requirements. The characteristic properties of cured Epoxy resin systems relevant to civil engineering applications are:

- High adhesive strength to almost all materials
- Low shrinkage during curing
- Exceptional dimensional stability

- Natural gap filling properties
- Thermosetting (does not melt)
- Resistance to most chemicals and environments
- Ability to cure in wet conditions and underwater (for selected grades)
- Ease of application

The other features of epoxy resin system, which are also to be considered as of immense importance during formulations, are as under –

- Diffusion Density - Epoxy plastic with relatively high vapour transmission resistance can be made open to diffusion and can be applied on, for example, wet concrete providing adhesion higher than the concrete's tensile strength.

- Pot Life – The epoxy's pot life is the hardening time that is defined as the time from the epoxy being applied until the formed epoxy plastic has achieved its final properties pertaining to strength and chemical resistance.

    - The pot life of the mixture containing all the ingredients in the prescribed proportions shall be at least 45 minutes at 27±2°C and at 65±5 percent relative humidity, when tested according to IS: 9162-1979 (Reaffirmed 2001).

Aside from the properties mentioned above, epoxy resins have two main drawbacks which are their brittleness and moisture sensitivity.

Other resins such as unsaturated polyester, polyurethane, etc. have also been used in civil engineering. Due to their higher shrinkage during curing, lower adhesive strength and mechanical properties, these resins have not found widespread application.

2.0 संरचनात्मक मरम्मत की आवश्यकता/NEED OF STRUCTURAL REPAIRS

The need of structural repairs can arise from any of the following:

- Faulty design of the structure causes distress during its service life and leads to get damaged the structure during extreme loading conditions like in severe earthquakes or cyclonic storm.
- Improper execution and bad workmanship results in poor quality of construction.
- Extreme weathering and environmental conditions causes premature distress in concrete structures due to corrosion of structural steel and affects structural stability of building.
- High degree of chemical attack due to presence of deteriorating agents like chlorides, sulphates and carbon dioxide in the environment
- Ageing of the structure due to lack of maintenance which results in deterioration/ageing of materials and structural components leading to corrosion and cracking.
- Settlement or differential settlement of foundation due to inadequate load bearing capacity of soil strata or additional floors to increase floor to area ratio.

3.0 इपॉक्सी रेजिन/EPOXY RESIN

Both epoxy and resin are adhesives and require mixing before use. Epoxy hardens much faster than resin glue. The drying time is different for both – Epoxy takes about 6-30 minutes while resin glues take longer to cure, about 8-10 hours.

The term 'epoxy resin' is a generic name of compounds that describe a broad class of thermosetting polymers in which the primary cross linking occurs through the reaction of an epoxide group. In general, an epoxy resin can be thought of as a molecule containing a three-membered ring, consisting of one oxygen atom and two carbon atoms.

Epoxy content is the measure of reactive epoxy groups present in an epoxy resin and is generally expressed in terms of epoxy content per 1000 g of resin.

As per IS 9197-1979 (Reaffirmed 2001), the epoxy resin is a liquid containing no hardeners and specified in two grades as Grade-1, in which resins contain no diluents and Grade-2, in which resins are modified with a reactive diluents. Each class of Grade 2 resin can be made with Grade 1 resin.

Epoxy resin is manufactured from simple basic chemicals that are readily available.

Propylene + Chlorine	=	Epichlorohydrin
Acetone + Phenol	=	Bisphenol
Epichlorohydrin + Bisphenol	=	Epoxy Resin

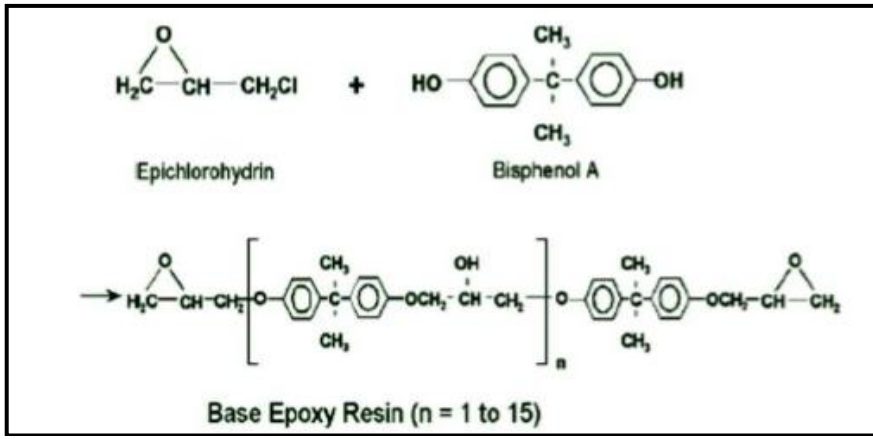
Epichlorohydrin: This is an organochlorine compound and an epoxide i.e. a colourless liquid with a pungent, garlic-like odour, moderately soluble in water.

Bisphenol: This is a colourless solid (commercial samples can appear yellow) organic compound that melts slightly above room temperature.
The most important raw material used in epoxy resin production is epichlorohydrin, which is used as a precursor for nearly every commercially available epoxy resin. The basic epoxy resin used in the building industry is **D**i**G**lycidyl **E**ther of **B**isphenol-**A** (DGEBA) that, in its simplest and most standard form, is the condensation product of bisphenol-A and epichlorohydrin. Depending upon the amount of excess of epichlorohydrin to bisphenol-A used in the manufacturing process, epoxy resins ranging from low molecular weight liquids to high molecular weight solids can be obtained.

However, basic resin of this type is not suitable for many applications because of its higher viscosity. Modification of basic resin is therefore,

necessary to achieve the required wet-ability, curing rate and numerous other properties in addition to lower viscosity. Modifying the ratio of epichlorohydrin to bisphenol-A during production can generate high molecular weight resin variants. This growth in molecular weight increases the viscosity, resulting in resins that are solid at room temperature.

In terms of chemical formulas, the relation is expressed as under:



In the formula for epoxy resin, the molecular weight determines what the epoxy resin depending upon the value of n = 1 to 15 can be used for.

- The low molecular epoxy resin is fluid at room temperature and can be handled without solvent additives, which evaporate and are therefore used for casting, thick coatings, gap-filling glues, etc.
- The high molecular epoxy resin is solid at room temperature and must as a rule be dissolved in organic solvents to be manageable, which limits usage to paints and lacquers.

To convert epoxy resin to epoxy plastic, a reaction with a suitable substance is required. Such a substance in this context is called a hardener.

Epoxy Resin is a high strength adhesive compound formed as a result of polymerisation (polyaddition or polycondensation reactions) of resin at ambient temperature in presence of a specified proportion of hardener and used as a thermoset polymer for adhesives and composites.

- Epoxy resins are a two-component system consisting of resin and hardener.
- By mixing the two components, a chemical reaction takes place so that the liquid resin gradually hardens to a solid plastic.
- Epoxy only takes between 6-30 minutes to cure.
- Epoxies can stick to wood, metal, glass, stone and some plastics, and are more heat- and chemical-resistant than most glues.

Most adhesives known as "structural "or "engineering" adhesives are epoxies and employed in construction industry.

4.0 इपॉक्सी क्यूरेटिव्स / EPOXY CURATIVES

The proper choice of a hardener/curing agent can be as important as the choice of resin itself, both playing a significant role in determining the extent and nature of inter molecular cross linking. This curing agent, commonly called as hardener, combines with the epoxy resin and changes it from a liquid to a solid.

Out of a vast number of compounds, most commonly used curing agents are aliphatic amines such as triethylenetetramine (TETA) and diethylenetriamine (DETA) and aromatic amines including diaminodiphenyl sulfone (DDS) and dimethylaniline (DMA) and polyamides and their adducts, which form room temperature curing compositions relevant to construction applications.

There are several categories of curing agents. Examples include:

A – As per IS: 9197-1979 (Reaffirmed 2001)

- **Aliphatic amines**
  - *(i)* Type A (viscosity at 25^0C - 10 to 20 MPa.s) - High rate of reaction with strong exotherm. Curing sensitive to humidity. Amount recommended per equivalent epoxy resin is 16 to 25 gram.
  - *(ii)* Type B (viscosity at 25^0C - 20 to 40 MPa.s) – Slow rate of curing with long pot life and low exotherm. Amount recommended per equivalent epoxy resin is 50 to 55 gram.
  - *(iii)* Type C (viscosity at 25^0C 3000 to 6000 MPa.s) – High rate of reaction and high exotherm. Amount recommended per equivalent epoxy resin is 50 to 55 gram.

- **Aromatic amines**
  - (i) Type A (viscosity at 25^0C – 3800 to 6000 MPa.s) – Permits curing at high atmospheric humidity and low temperature, medium rate of curing. Amount recommended per equivalent epoxy resin is 110 to 130 gram.
  - (ii) Type B (viscosity at 25^0C – 14000 to 22000 MPa.s) – Permits curing at high atmospheric humidity and low temperature, fast rate of curing. Amount recommended per equivalent epoxy resin is 110 to 130 gram.

- **Polyqminoamide**
  - (i) Type A (viscosity at 25^0C – 12500 to 17500 MPa.s) – Slow rate of curing with low exotherm. Amount recommended per equivalent epoxy resin is 110 to 190 gram.
  - (ii) Type B (viscosity at 25^0C – 14000 to 15000 MPa.s) – Slow rate of curing with low exotherm. Amount recommended per equivalent epoxy resin is 100 to 110 gram.
  - (iii) Type C (viscosity at 25^0C – 9000 to 13000 MPa.s) – Slow rate of curing with low exotherm. Amount recommended per equivalent epoxy resin is 160 to 180 gram.

- **Amino resin compound**
  (i) Type A (viscosity at 25^0C – 17000 to 23000 MPa.s) – Possibility of adjusting pot life and exotherm. Amount recommended per equivalent epoxy resin is 100 to 110 gram.

B – Other Curing agents/ Hardeners

- **Anhydrides** such as phthalic anhydride and nadic methyl anhydride (NMA);
- **Amine/phenol formaldehydes** such as urea formaldehyde and melamine formaldehyde;
- **Catalytic curing agents** such as tertiary amines and boron trifluoride complexes. Tertiary Amines are generally recommended as accelerators.

Some other resins/ elastomers such as phenol formaldehyde resin, thermosetting acrylics, isocynates and polysulphides are also used as co-cross linking agents with amines to obtain the desired properties of the finished products. They are mostly used for corrosion resistant linings, food and beverages containers / tank coatings, etc.

5.0 इपॉक्सी मॉडीफायर्स / EPOXY MODIFIERS

It is easy to understand that an unmodified epoxy resin can not always be used outdoors or where the temperature is low. The first reason for modification is the viscosity reduction to a suitable working consistency.

The modifiers are used to provide specific physical and mechanical performance in both the uncured and cured resin. General categories of modifiers include rubbers, thermoplastics, diluents, flame retardants, fillers and pigments and dyes. These are briefly described as below:

Rubber Additives: These are used to increase flexibility, fatigue resistance, crack resistance, and energy absorption (toughness) in epoxy resins. These polymers may be employed as liquid, solid, or particulate

components in a formulation. The liquid rubbers most often used in epoxy composites are carboxyl-terminated butadiene acrylonitrile copolymers. The acrylonitrile content of the rubber is an important consideration when choosing a rubber modifier.

Diluents: These are used for lowering the viscosity and improving handling characteristics of epoxy resin and are classified as:

- ***Reactive Diluents*** are mostly low molecular weight glycidyl ethers with low viscosity, which reduce the cross link density of the system.
- ***Non-reactive Diluents*** such as toluene, xylene and other aromatic hydrocarbons can bring about significant reduction in the viscosity of low molecular weight resins. A popular non reactive diluent is dibutylpthalate, used with a liquid resin.

  Note: Diluents or plasticizers may be incorporated to the extent that they should not affect the requirements of pot life, curing time and strength. However, the total percentage of these materials added to the resin hardener system shall be specified by the suppliers.

Flame Retardants: These can be added to epoxy resins as filler, or the matrix can be built to incorporate flame retardant characteristics. Generally, the more carbon and hydrogen in a polymer system, the more flammable it is. The presence of halogens and char-forming aromatics in the epoxy curative based resin decreases flammability.

Un-reactive Fillers: Fillers are used in epoxy resins as extenders, reinforcements, and to impart specific physical characteristics such as low density, low flow, shrinkage reduction, and thermal and electrical conductivity. The types of fillers used vary widely but can generally be categorized as minerals, metals, glass, fibers, carbon, and miscellaneous organics. Physically, they can be used in a variety of forms including powders, pulps, flakes, flocks, spheres, micro-balloons, short fibers, and whiskers.

Pigments and Dyes: Epoxy resins may be coloured using a wide variety of pigments and dyes, both organic and inorganic. Pigments are insoluble particles dispersed in a resin, whereas dyes are soluble organic molecules. Dyes are not suitable for epoxy composite applications due to temperature limitations.

- Pigment is used to colour the epoxy material, and the filler to increase the mechanical strength and to reduce costs. The pigments used are most often metal oxides such as titanium dioxide, iron oxide and chromium oxide. As a rule, fillers are finely ground minerals and quartz sand. It is important that both pigments and fillers are properly dispersed in the epoxy binding agent.

6.0 इपॉक्सी रेजिन सिस्टम्स/EPOXY RESIN SYSTEMS

Epoxy resin systems are made up of an epoxy resin and a curing agent (also called a hardener or catalyst). Many epoxy products contain additives such as organic solvents, fillers such as fiberglass or sand, and pigments.

Coal Tar Epoxy System: Coal Tar epoxy resin combinations with polyamine hardener have been widely used as water resistant protective coatings. Coal Tar plays an important part in the improvement of corrosion resistance of epoxy resin system. It is Coal Tar/Epoxy in proportion of 40:60, which has been reported to give optimum results under aggressive environment. As recommended in Para 5.4.7 of IRS Concrete Bridge Code 1997 (updated to the latest), the Coal Tar Epoxy coating can be used in substructure of bridges (in affected part only) against aggressive environment.

Rubber Modified Epoxy System: This system is used to improve the drawback of brittleness and low elongation of unmodified epoxy resin based on bisphenol-A and epichlorohydrin with hardeners such as polyamines and anhydrides. The system possessing both small and large particles provides maximum toughness. The most widely used toughner in epoxy resin is a liquid carboxyl-terminated butadiene acrylonitrile.

Epoxy Phenolic IPN Systems: Central Building Research Institute (CBRI), Roorkee has developed an Epoxy-Phenolic Interpenetrating Polymer Network (IPN) system for protection of structural steels and now extended to rebar. IPNs are relatively novel types of polymer alloys consisting of two or more polymers in network forms, at least one of which is synthesized and/or cross linked in the immediate presence of the other. Polymer phases are devoid of chemical linking between them interwoven to each other and help together by permanent entanglements.

Composite Fibre System: The system comprises of a fiber reinforcement layer that is wrapped to the exterior surface of the structural element to be retrofitted. The fiber composite reinforcement layer consists of at least one fabric layer that is located within a resin matrix. The primary fibres are oriented in a desired direction with reference to the axis of the structural element concerned. The composite reinforcement layer provides a quick, simple and effective means for increasing the resistance of the structural element to failure during the application of loads. All the components of the composite (epoxy, fabric etc.) shall be fully compatible and supplied by a supplier that is competent in the technology, design, installation and materials of the composite system.

Epoxy Mortar and Concrete: Epoxy resins are used with aggregate (silica sand) to produce epoxy mortar or epoxy concrete, which is used for structural repairs of concrete, RCC besides its use in new construction in industrial flooring, foundation grouting, roads etc. They are normally used where volume of materials is not large and where rapid curing can be obtained. Epoxy Resins and epoxy resin based mortar possess several important characteristics which can be advantageously used for civil engineering applications.

7.0 खॉचादार पीआरसी स्लीपरों का इपॉक्सी आधारित उपचार/EPOXY BASED TREATMENT OF GROOVED PRC SLEEPERS

The damage of GRP (Grooved Rubber Pad) and formation of groove in PRC sleeper rail seats is a major problem due to the curves (more than 6

degree and gradient steeper than 1 in 100) consisting of fish plated joints at every 6.5 meter length in track. An innovative idea to repair the grooved sleepers with epoxy is the only feasible, economical and quick solution to keep the gauge within permissible limits.

The epoxy resin (DGEBA) and the hardener are to be mixed for starting the chemical reaction of hardening. For preparing the mortar, some silica flour is added to aggregates as per manufacturer's recommendation for the best application. The epoxy mortar so prepared has a compressive strength more than that of concrete of PRC sleeper.

Procedure:

- Every one sleeper after 10 sleepers is removed from the running track.
- The rail seat is cleaned with wire brush and cleaner chemical to make the surface free from grease, oil, loose materials and dust.


RAIL SEAT BEFORE REPAIR

- The rail seat surface is raked out with wire brush for ensuring proper bond and grip.
- One coat of epoxy primer on rail seat is applied in dry and clean condition.
- The groove portion is filled with epoxy mortar using template.
- The repaired groove portion is trimmed and allowed for curing for at least 5-6 hours on cess.


RAIL SEAT AFTER REPAIR

- GRP on sleeper is fixed over repaired rail seat with adhesive.
- The repaired sleeper is inserted back onto track with doing necessary packing.

8.0 संरचनाओं में दरारों की इपॉक्सी आधारित इंजेक्शन ग्रॉटिंग/ EPOXY BASED INJECTION GROUTING OF CRACKS IN STRUCTURES

As compared to cement, epoxy is quick setting, has very low shrinkage, excellent adhesion, high strength, low viscosity to penetrate even hair cracks and good resistance to most of the chemicals. However, epoxy grouting, being expensive, should be used only when it is techno economically justified.

A very low viscosity epoxy resin and hardener composition is used for injection grouting of cracks. Grouting of wide cracks require large quantity of grout material. In such cases suitable fillers e.g. dry silicon flour etc. can be added based on manufacturer's recommendations. Considering the width, depth and extent of cracks and other relevant details, the viscosity of the resin hardener mix, their proportions, pot life, application procedure etc. should be chosen in consultation with the manufacturers. The shear strength on a specimen of two mild steel plates should not be less than 100 kg/cm^2. The epoxy mortar should not be susceptible to fire and explosion during injection process and must be stable under varying climatic conditions.

Equipments required

- Pneumatic or electric hole drilling equipment.
- Pressure injection equipment of standard make with necessary control valves and gauges, etc.
- Air compressor of capacity 3 to 4 cum/min. and pressure of 10 kg/cm^2.
- Polythene or metal pipe pieces 6-9mm dia.
- Polythene/plastic containers for mixing the epoxy formulation.
- A portable generator.

Procedure for epoxy grouting

- The area to be grouted should be dry and free from oil, grease, dust and all loose and unsound materials.
- All cracks should be cut open to a 'V' groove about 10mm deep by mechanical or manual means. Loose material should be removed by using compressed air and groove fully sealed using epoxy mortar at least one day in advance.
- Nails are driven into the cracks at 15 cm to 50cm intervals along the crack.
- Holes of 7 - 10 mm dia should be drilled along the cracks and copper or aluminium or polythene pipe pieces of 6 - 9 mm dia fixed as grout nipples around the nails and allowed to rest on them.



- Epoxy formulation is injected from the bottom most pipe, keeping all other pipes, except the adjacent ones, blocked by wooden plugs. The injection is done using suitable nozzles connected to air compressors or by hand operated modified grease guns. Pressure of 3.5 to 7 kg per sq. cm is normally used. As soon as the epoxy comes out from the adjacent open pipes, they are plugged and the pressure increased to the desired level and maintained for 2 to 3 minutes. The injection nozzle is then withdrawn and the hole sealed with epoxy mortar. This operation is repeated for the other pipes also. Any resin that remains or overflows the copper pipe is scraped off with a metal spatula and the surface cleaned with a rag soaked in noninflammable solvent.
- Due to restriction of pot life, it is advisable to mix only small quantities of epoxy at a time. All proportioning should be by weight and mixing should be thorough.
- Low viscosity resins may be adopted for thin cracks.
- A record of materials consumed should be maintained.

Note: Epoxy coatings in conjunction with epoxy grouting have been used to render leaking roofs, toilets, bath rooms as impervious. However, their use in exposed locations directly exposed to sunlight is to be avoided.

9.0 पुरानी कंक्रीट का नई कंक्रीट के साथ इपॉक्सी आधारित जोड़/EPOXY BASED BONDING OF OLD TO NEW CONCRETE

Epoxy resin with a special polyamide hardener combination is successfully used for bonding old to new concrete. A test carried out by CSMRS, Delhi shows the bonding strength improvement after using epoxy resin as intermediate layer in monolithic bonding between old and new concrete. The process consists of:

- Removal of all loose and damaged concrete using mechanical means or water jet.
- Surface to be dried.
- A suitable epoxy resin [unmodified solvent-less epoxy resin and polyamide hardener (special grade)] is applied with stiff nylon brush.
- The fresh concrete should be poured when epoxy coating has become just tack free.
- Care should be taken not to completely dry the coating.
- In the case of epoxy bonding, no separation is observed almost up to failure in the concrete.

10.0 इपॉक्सी आधारित संक्षारक विरोधी बचाव रुपी परतें/EPOXY BASED ANTI CORROSIVE PROTECTIVE COATINGS

Fusion Bonded Epoxy Powder Coatings (FBEC) as well as IPN Coatings is being used for protection to reinforcing bars against corrosion in RCC structures located in highly aggressive environment. FBEC process provides a tough film, which can withstand bar bending without cracking, whereas IPN coatings are used for new constructions for in situ coatings to steel reinforcement. IPN coatings are also used as surface coatings for RCC structures for arresting further carbonation of cover concrete or other

chemical attack by sealing their surface against ingress of environmental aggressive chemicals and their consequential attack on concrete.

Two different resins i.e. *Medium viscosity epoxy resin based on epichlorohydrin and bisphenol as base and an aromatic amine adduct as the cross-linker* and *Phenolic resin obtained from an indigenous phenol with its cross-linker* are mixed in different ratios and cross-linked simultaneously by a separate non interfering mechanism. These are used with advantage in coatings for protection of concrete structures and steel reinforcement bars against corrosion due to their good resistance to chlorides and chemicals.

The method of application is as follows:

- For cleansing the surfaces of rebars, sand blasting/ shot blasting is done to remove rust and other deleterious material in a shed provided with proper ventilation.
- The first coat of Epoxy phenolic-IPN is applied by means of brush/ spray within 4 hours of sand blasting/ shot blasting.
- The application of coat should be done on a high platform of wood or steel where the rebars can be kept at ease.
- For effective polymerisation within 4 to 8 hours after the application of first coat. Resin component and Hardner component of Epoxy phenolic-IPN coating are mixed in plastic container in 1:1 proportion by volume and vigorously stirred for 5-10 minutes and then the mixture is allowed to remain in the container for another 5-10 minutes. The mixture is ready for use. The plastic container should be clean and free from moisture, grease oil, etc.
- The mixture is applied by means of brush/spray.
- The treated rebar should be cured for 48 hours after the application of first coat.

Note:

1. Para 5.4.7 of IRS Concrete Bridge Code 1997 (updated to the latest) can be referred for recommended Epoxy-Phenolic IPN coating in order to provide adequate resistance against corrosion of embedded material in RCC super structure of bridges in aggressive environment.
2. Para 7.1.5 of IRS Concrete Bridge Code 1997 (updated to the latest) can be referred for recommended Fusion Bonded Epoxy Coating (FBEC) in order to offer adequate resistance against corrosion of reinforcement bars in important and major bridges in aggressive environment.

Epoxy based Paints:

A - For locations where girders are exposed to corrosive environment i.e. flooring system of open web girders in all cases, girders in industrial, suburban or coastal areas etc., protective coating by painting with epoxy based paints may be applied:

i) Surface Preparation:

a) Remove oil/grease from the metal surface by using petroleum hydrocarbon solvent to IS: 1745.
b) Prepare the surface by sand or grit blasting to Sa 2½ to IS: 9954 i.e. near white metallic surface.

ii) Painting:

a) **Primer coat:** Apply by brush / airless spray two coats of epoxy zinc phosphate primer to RDSO specification No. M&C/PCN-102/86 to 60 microns minimum dry film thickness (DFT) giving sufficient time gap between two coats to enable first coat of primer to hard dry.

b) **Intermediate coat:** Apply by brush/airless spray-one coat of epoxy micaceous iron oxide to RDSO specification No. M&C/PCN-103/86 to 100 microns minimum DFT and allow it to hard dry.

c) **Finishing coat:** Apply by brush/airless spray two coats of polyurethane aluminium finishing to RDSO Specification No. M&C/PCN-110/88 for coastal locations or polyurethane red oxide (red oxide to ISC 446 as per IS : 5) to RDSO Specification No. M&C/PCN-109/88 for other locations to 40 microns minimum DFT giving sufficient time gap between two coats to enable the first coat to hard dry. The finishing coats are to be applied in shop and touched after erection, if necessary.

B - Initial painting of weld collar can be done with high build Epoxy paint consisting of two pack as per RDSO's specification No. M&C/PCN/111/88 in Heavy Corrosion prone area.

Note: *Vide A&C Slip No.5, dated 30.08.2013, the RDSO specifications to IRS-B1-2001 as mentioned in A and B above have been replaced with M&C/PCN-102/2009 (Primer Coat)[1], M&C/PCN-103/2011 (Intermediate Coat)[2], M&C/PCN-110/2006 (Finishing Coat for Coastal locations)[3] and M&C/PCN-109/2009 (Finishing Coat for other locations)[4] and M&C/PCN-111/2006 (Initial painting of Weld Collar in heavy corrosion prone area)[5].*

Specification No. as amended	***Name of Specification***
[1]M&C/PCN/102/2009 with RDSO Amendment No. 1B w.e.f. 08.09.2016	*Specification for Epoxy cum Polyurethane Painting System (Two Pack) for the Exterior Painting of Railway Coaches, Diesel And Electric Locomotives and other Industrial Applications.*
[2]M&C/PCN/103/2006 (Reaffirmed-2011)	*Specification for Epoxy-MIO (Micaceous Iron Oxide) (Two Pack)*
[3]M&C/PCN/110/2006 (Reaffirmed-2013)	*Specification for Polyurethane based Aluminium Paint (Three Pack)*
[4]M&C/PCN/109/2009 with RDSO Amendment No. 1B w.e.f. 08.09.2016	*Specification for Full Gloss Red-Oxide Polyurethane Enamel for Wagons, Bridges & Structures and other Industrial Applications (Two Pack)*
[5]M&C/PCN/111/2018	*Specification for High Build Epoxy (Two Pack)*

11.0 इपॉक्सी आधारित अन्य उपयोग / EPOXY BASED OTHER APPLICATIONS

1. **Epoxy Based Self Flow Micro Concrete** is highly fluidic, non-shrink, self compacting concrete with very high early ultimate strength, excellent adhesion and possesses excellent mechanical properties and bonds with almost all building materials. It is suitable for sealing crack surface defects, concrete repair, thin jackets, thin film bonding, assembly of pre-stressed concrete segmental units and segmental bridge construction. It is also used for structural repairs like Jacketing, patch repair, retrofitting of RCC, grouting foundations, anchor bolts. It is not suitable in exposed location, at high temperatures or where temperature variation range is large.
2. **Epoxy Based Quick Setting Compounds,** rapidly sets concrete/mortar to yield early strength.
3. **Epoxy Based Floor Hardener,** possesses excellent abrasion resistance and other mechanical properties.
4. **Epoxy Based Acid Resistance Enhancer,** is an acid resistant coating for concrete and steel (Non-resistant to UV radiation). It possesses excellent bonding and adhesion under dry and wet conditions both.
5. **Epoxy Based Anchoring,** depends upon the area to be sealed. The number of capsules to be used is dependent on the pull out force. The capsules are manufactured in wide range of diameter between 25 to 40 mm and in 3 different lengths. The borehole diameter is about 8mm bigger than the anchor bolt diameter. In general, for 12 t pullout force, 3x30mm dia x 300mm length capsules are sufficient.
6. **Epoxy Based Water Proofing Compounds** are used as surface coatings as well as Integral Water Proofing Compound, which seals pores & network of fine cracks, good bonding, withstands positive water pressure, resists chemicals aggression.
7. **Epoxy Based Repair mortar/Concrete** may not be suitable in exposed location, at high temperatures or where temperature variation range is large. It possesses excellent mechanical properties and bonds with almost all building materials, wherever to be applied in thin layers.

8. **Epoxy Based Anti Carbonation Protective Coating on Concrete** possesses high adhesive, excellent dimensional stability, ability to cure dry conditions, good chemical resistance, and excellent mechanical properties. The protective coating is likely to be adversely affected at high temperatures as well as under UV exposure.
9. **Epoxy Based Protective Coat on Steel** is a non-resistant to UV radiation, exposed locations and high temperatures. It protects Steel against corrosion. Zinc rich primer is used to avoid corrosion. It is Anti-corrosive, chemical resistant, water proof and has good bonding.

12.0 अपनाई जाने वाली सावधानियॉं / PRECAUTIONS TO BE TAKEN

The chemicals in epoxy resin systems can affect the health of a person during handling these chemicals. The main effects of overexposure are irritation of the eyes, nose, throat, and skin, skin allergies, and asthma. The solvent additives can cause other effects such as headaches, dizziness, and confusion.

Epoxies are generally toxic in nature and these require lot of care in their handling. The special care required to be taken during their mixing and applications are as under:

- They should not come in contact with the skin. Workers should be provided with rubber gloves.
- In case of eye contact, immediately rinse the eyes with water. Continue rinsing for about 15 minutes and then seek medical attention.
- The utensils/ equipments used for the mixing resin and hardener should be cleaned immediately after their use.
- The pot life of the mixed epoxy is generally very limited, ½ to 2 hours. Therefore, material should be prepared just sufficient to cover the area within the pot life period as recommended by the manufacturers.
- Epoxies have much higher bond strength than other polymers, but at the same time, these are costlier.

- Manufacturer's detailed instructions should be followed for safe handling and processing.
- The grease gun syringe should be washed with acetone immediately after use.

13.0 व्यापारिक रुप से उपलब्ध इपॉक्सी आधारित उत्पादित वस्तुऐं/COMMERCIALLY AVAILABLE EPOXY BASED PRODUCTS

Some of the epoxy based products as mentioned in the table below are not a part of the approved vendor list. The information based on details available on manufacture' websites has been given here for reference purpose only. User may refer relevant manufacture's guidelines before actual implementation of the product in the civil engineering applications.

S. No.	Name of Product	Application	Name of Manufactures
1.	**CERA SCREED EPLV** (High performance non shrink epoxy grout)	Injection grouting	Cera-Chem Private Limited, No.9, Sterling road, first cross street, Nungambakkam, Chennai-600034, Tamil Nadu. Email: corporate@cerachemindia.com
2.	**CERA BOND EP** (Epoxy bonding agent for structural concrete)	Bonding of old to new concrete	
3.	**CERA ZINC ZR** (Epoxy zinc rich primer)	Protective coat on steel	
4.	**MASTER- GROUT EP – 150-G** (Two pack epoxy resin system for injection grouting and for granting gap widths of 0.25 to 10 mm)	Injection grouting	Choksey Chemical Pvt.Ltd., 111-Industrial Area, Sion, Mumbai-400022. www.chokseychem.com
5.	**MASTER- BOND – EP** (Two pack epoxy resin bonding agent providing strong bond between old concrete and new concrete)	Bonding of old to new concrete	
6.	**TECH FLOOR SL -2** (Self levelling polysulphide Epoxy floor coating	Acid resistant coating for concrete and Steel	

	provides a hard-wearing attractive floor which is chemical resistant, impervious and extremely clean)		
7.	**EPCO KP/HP-250 SSLV** (Slow Setting Low Viscosity Epoxy Injection Grouting System can be used for pressure grouting of concrete surfaces for filling of cracks)	Slow Setting Low Viscosity Epoxy Injection System	Krishna Conchem Products Pvt. Ltd. (KCPPL). Building Number 6, Millenium Business Park, MIDC Industrial Area, Sector 3, Kopar Khairane, Navi Mumbai, Maharashtra 400710 Telephone/Fax 022- 2778 29 23 / 24 **Email Address** info@krishnaconchem.com
8.	**EPIBOND** (Bonding New To Old Concrete. Useful for concrete joints for bonding old to new concrete, to be applied by brush over old surface and concreting should be done after coat becomes tacky).	Bonding New to Old Concrete	
9.	**EL MONOBOND** (Two Component Non Re-emulsifiable Epoxy Latex System. Can be applied on Concrete and plain or plastered surface, into wet areas also. Useful for Waterproofing of sunken slabs,basement,roofs etc. Can be used as bonding agent also).	Two Component Non Re-emulisifiable Epoxy Latex System	
10.	**CORROSEAL** (Two pack polyamide cured air drying epoxy compound. CORROSEAL has excellent resistance to corrosion. Protection of Concrete & Steel structures. Typically Bridge Decks, Piers, Foundations, Marine Structures, Water Retaining Structures, Cooling Towers,	Protection of Concrete and Steel Structure	

	Chimneys etc. Protective coatings to Structural Steel, Metal Pipes, Frames, Grills, Tanks, Manhole covers, Drainage systems, M. S. Pile Liners).		
11.	**IPNET** (Protective coating for concrete Bridges, Bridge Decks, Girders. Pier columns, Parapet, Pipelines and Plant lying in saline atmosphere / marine environment conditions).	Interpenetrating Polymer Network Concrete Coating System	
12.	**WATERSEAL** (Food Grade Epoxy – Stearate Protective Coating. Waterseal is a unique formulation that provides positive ® waterproofing to the structure. Waterseal is a chemically cured epoxy stearate compound of base and curing agent to be mixed in equal proportion by volume prior to the application).	Food Grade Epoxy - Stearate Protective Coating	Krishna Conchem Products Pvt. Ltd. (KCPPL). Building Number 6, Millenium Business Park, MIDC Industrial Area, Sector 3, Kopar Khairane, Navi Mumbai, Maharashtra 400710 Telephone/Fax 022- 2778 29 23 / 24 **Email Address** info@krishnaconchem.com
13.	**ZEROKORR** (Incorporate specialized polymer having self-healing properties which passiveate pinholes by virtue of redox mechanism. These systems protect the steel mostly by virtue of being barrier in nature).	Self Healing Anti Corrosive Coating System for Steel	
14.	**GOLDBOND 1893** (Two part specialty system comprising of a primer part and a saturant part. Primer is comprised of a base and curing agent. Saturant is also comprised of a base and	Epoxy Primer & Saturant System for E-Glass/Carbon Fiber Applications on Concrete	

	curing agent. In wrapping of unidirectional e-glass fiber sheets / carbon fiber sheets to concrete structural elements for structural strengthening and seismic retrofitting applications).		
15.	**MC DUR 1264** (Low viscosity Epoxy Resin for use in rigid filling by injection or deep penetration of cracks, joints and voids in building construction and civil engineering under dry conditions)	Injection grouting	MC-Bauchemie (India) Pvt. Limited B-501, Shelton Sapphire Building, Sec-15, C.B.D. Belapur, Navi Mumbai 400614 India, Phone: +91-222772856/27570803, +91-2227563867/27563870, www.mc-bauchemie.in
16.	**MC DUR 1200** (Two component, pigmented epoxy resin coating for use in industrial areas or similar, grouting of steel anchors)	Bonding of old to new concrete	
17.	**SUNEPOXY 368** (Very low viscosity epoxy injection grout material provides structural integrity, high bond strength)	Injection grouting	Sunanda Speciality Coatings Pvt. Ltd. Sunshine Tower, 36th Floor, Senapati Bapat Marg, Lower Parel, Mumbai – 400013, India. +91 22 6226 8000 (100 lines) E-mail- info@sunandaglobal.com
18.	**SUNEPOXY 358** (Two component high viscosity epoxy resin for use in corrosion protection of steel, bond coat for old and new concrete, joints of metals, flooring screed, etc.)	Bonding of old to new concrete	
19.	**1. ICOSIT K25 (I)/3** (Two part epoxy resin based protective coating for use on concrete, cementitious mortars and rendering, epoxy mortars, steel, stone, wood, etc.) **2. FRIAZINC R** (Two component, low solvent, zinc rich epoxy resin based primer for steel)	Protective coating	Sika India Pvt. Ltd. 501 & 502, B Wing, Lotus Corporate Park, Off. Western Express Highway, Goregaon East Mumbai – 400063 Tel: +91 2262704038 Fax: +91 2262704039 Email: info.india@in.sika.com

20.	**HIBOND** (Epoxy based, two component structural bonding agent applied between old and new concrete surfaces during casting of roof slabs, retaining walls, water tanks, extension of balconies, etc.)	Bonding of old to new concrete	
21.	**CICO POXY-21 LV** (Low viscosity high strength injectable epoxy grout is a two component solvent free, free flowing, fast curing system used to grout fine cracks, voids and fissures of concrete structures and rocks)	Injection grouting	CICO Technologies Limited, C-44/2, 1st & 2nd Floor, Okhala Industrial Area, Phase-II, New Delhi +91 11-40509400 Email: cicotech@cicogroup.com
22.	**CICO BOND EPO** (Two components 100% solid epoxy resin system used as a high strength bonding agent for mortars, renders, stone, steel, iron, etc.)	Bonding of old to new concrete	
23.	**CICO POXY SBA** (Thixotropic epoxy resin adhesive for segmental bridge construction)	Self flow micro concrete	
24.	**CICO POXY TC 200** (Two component solvent free epoxy coating system for water proofing, dust proofing of concrete walls, floors and ceilings. Suitable for use on all types of structures, especially those in aggressive marine and coastal environment)	Water proofing coating	
25.	**CICO RESIFIX** (A polyester resin cartridge consisting of two components – resin grout	Anchoring of bolts, etc.	

	and its catalyst, used for anchoring bolts into rock or concrete for the purpose of mining, tunnelling, etc.)		
26.	**CICO GROUT GP** (An expanding non-ferrous grout, consisting of a dry pre-mixed blend of special grade cement, siliceous aggregate with set regulating and reactive compounds in powder form. Non-shrink ready to use Cementitious Grout suitable for grouting of machine bases – steel and pre-cast concrete anchor bolts and similar grouting applications.)	Acid resistant coating for concrete and Steel	CICO Technologies Limited, C-44/2, 1st & 2nd Floor, Okhala Industrial Area, Phase-II, New Delhi +91 11-40509400 Email: cicotech@cicogroup.com
27.	**CICO TAPECRETE P-151** (An acrylic based Polymer Modified Cementitious Flexible Composite coating system in conjunction with cement provides properties to improve high adhesion high impact strength, increase flexural strength and thin section fragility.)	A Surface Treatment System for Protecting Concrete & Masonry from ingress of water and when mixed with cement mortar can be used as a repair mortar	
28.	**CICO MICROCRETE** (A specially prepared ready-to-use grey powder which requires addition of water only at job site. To produce free flowing and semi fluid/plastic high strength concrete which has micro fine aggregate and ability to penetrate into the recesses of concrete members behind the reinforcement of the structure under repair.)	High Strength Micro Concrete for Repair	

29.	**CICOPOXY 215** (A three component solvent free, free flowing, fast curing epoxy resin system which can be injected/ poured in/on concrete for carrying out structural repairs. The cured resin possesses high mechanical strength, excellent adhesion, non-shrinking properties and a chemical resistance to acids.)	High Strength Injectable/Pourable Epoxy Grout	
30.	**FLOWGROUT EPLV** (Two part, pre formulated, low viscosity epoxy resin used for injection of cracks and cold joints in concrete structures. Suitable for damp or dry surface)	Injection grouting	FAIRMATE Chemical Pvt Limited, 8/1, SAI Sudha, Arunoday Society, Alkapuri, Vadodra-390007 www.fairmate.com
31.	**FAIRBOND EP** (two pack, solvent free, epoxy based concrete bonding agent)	Bonding of old to new concrete	
32.	**SAFECORE EP (S)** (High performance solvent based coating with minimum surface preparation, provides resistance to mild alkali and acid for steel surfaces)	Protective coat on steel	
33.	**SAFECORE EP (F)** (High build and decorative solvent based chemical resistant coating for industrial floor and walls)	Protective coat on concrete	
34.	**ANCHORGROUT** (High strength thixotropic, two part polyester resin grout. Suitable for grouting of steel bars bolt into concrete, stones, machinery and brick work)	Anchoring of bolts, etc.	

35.	**FIBPOXY (IR)**	Injection grouting	Fibrex Construction Chemicals Priva Limited Building no. 2, Site no-1, Lajwanti Complex, 2 & 3 Floor, Near Metro Pillar No. 562 & 563 14/3 Mathura Road Faridabad, Haryana 121003 Tel: 0129-4081412 Email:sales@fibrexchem.com
36.	**FIBBOND 253** (Two component epoxy bonding adhesive for concrete)	Bonding of old to new concrete	
37.	**FIBMICROCRTE** (High strength material for use in parking decks, floor toppings, joint repairs, equipment bases, pedestals, pavements)	Self flow micro concrete	
38.	**SHALIPOXY CTE A** (A self priming two component Coal Tar Epoxy Based Anti-corrosive coating used in corrosive environment to provide exceptional resistance to the effect of water immersion, salt water, oil, acids, alkalies, crude oil, minerals etc. and excellent resistance to impact, thermal shock and abrasion)	Applicable in Tanks, Piping (Concrete, steel), Sheet, pipe Piling, Concrete and Steel surfaces in sewage treatment, Dams, Barrage gates, Penstocks. Foundation walls and sumps, Underground Structures	STP Limited: Sri Hasan Rizvi (Sr. VP STP Ltd.) 707, Chiranjiv Tower, 43, Nehru Place, New Delhi - 110019, Delhi, India Telephone: +(91)-(11)-46561359, Fax: +(91)-(11)-46561358 Email- info@stpltd.com, hasan@stpltd.com
39.	**SHALIPOXY CTE 303** (A two component, high build anti-corrosive/ protective flexible coal tar epoxy coating for steel and concrete giving 300 micron in single coat on wet-on-wet basis and possesses excellent corrosion/chemical/abrasion/ scratch resistance. It also provides excellent resistance to impact, thermal shock and abrasion, sea/ salt water, oil, acids, alkalis, crude oil and minerals and used as direct to metal (DTM) application, without any requirement of primer)	Applicable in MS/ concrete pipes and metallic structures, Concrete and Steel surfaces in sewage treatment plant, Foundation walls and sumps	

40.	**SHALIFIX EM** (A 100% solid, solvent free, high performance, non-slumping, three component Epoxy Mortar consisting of an epoxy resin, hardener and selected graded filler, providing a tough and resilient, surface when compared to concrete)	Car parks & workshops, warehouses, Metal treating plants	STP Limited: Sri Hasan Rizvi (Sr. VP STP Ltd.) 707, Chiranjiv Tower, 43, Nehru Place, New Delhi - 110019, Delhi, India Telephone: +(91)-(11)-46561359, Fax: +(91)-(11)-46561358 Email- info@stpltd.com, hasan@stpltd.com
41.	**SHALIBOND CONCRETE** (A 100% reactive two component epoxy bonding adhesive/ primer, solvent free bonding agent for old concrete with new concrete as well as two concrete pre-cast blocks possesses resistance against chemical attack including most acids and caustics.)	Bonding of old to new concrete/flooring and toppings /floor & joint and as a primer for roads, bridges, pavements, loading bays and factories.	
42.	**SHALIGROUT EI** (A 100% reactive, two component epoxy injection grout for structural strengthening provides a tough, weather resistant seal for porous concrete)	Injection Grout for structural strengthen-ing of Parking structures Bridge structures, Retaining walls, Earthquake damage structures	
43.	**SHALIPRIME 2E SF** (Two Component transparent, solvent free, Epoxy Primer for better bonding of Epoxy Floor Topping, Epoxy Screed and Epoxy Mortars with the substrate, and sealing porous surface to give quality finish)	As a Primer for Concrete Surfaces including walls, prior to the application of any Epoxy flooring or coating, epoxy repair mortar	
44.	**SHALIPRIME ERO** (Two Component cold cure epoxy based Anti Corrosion Red Oxide Epoxy Primer for excellent durability to all	As anti-corrosive primer on steel surfaces.	

	types of chemical environment)		
45.	**SHALISEAL EMS** (Two Component semi-rigid Epoxy Modified Sealant for tough performance reducing floor joint repairs and rate of deterioration while filling cracks)	As a sealant for control and construction joints in industrial concrete floors	
46.	**SHALIBOND S** (Two Component, solvent free, thixotropic, structural adhesive provides high strength and high modulus of elasticity and good chemical resistance)	As adhesive for Segmental Bridge	
47.	**SHALIFLOOR TC 2HBE** (Two Component High Build Epoxy Top Coating with high resistance to abrasion prevents bacterial growth and corrosion when used on metallic surface)	As a coating to provide dust free floor surface (hygienic monolithic floor) for operation theatres & corridors in hospitals, computer and control panel rooms, workshops	STP Limited: Sri Hasan Rizvi (Sr. VP STP Ltd.) 707, Chiranjiv Tower, 43, Nehru Place, New Delhi - 110019, Delhi, India Telephone: +(91)-(11)-46561359, Fax: +(91)-(11)-46561358 Email- info@stpltd.com, hasan@stpltd.com
48.	**SHALIFLOOR TC 2ARE** (Two Component, room temperature cured, 100% solid Acid Resistant Epoxy Floor Coating provides excellent adhesion and resists various acids)	As a floor coating in chemical storage tanks and pumps to protect floors, and metal surfaces subjected to acids and bases	
49.	**SHALIPROTEK NES 70** (A two component anti-corrosive chemical resistant novolac based phenolic epoxy provides excellent resistance to acid and alkali vapours emanating at high temperature. It bonds well at low temperature & humidity)	As a coating for concrete flooring exposed to acid / alkali fumes emanating at high temperature, like in Ammonium Sulphate / Annealing / Acid Plants	

50.	**SHALIFIX 3EP** (A three component, non-shrink, epoxy based, putty provides excellent impact resistance, good mechanical and bonding properties)	As protective coating for protection of concrete, steel, marine structure. Sealing of crack for concrete, metal and wooden surface.	STP Limited: Sri Hasan Rizvi (Sr. VP STP Ltd.) 707, Chiranjiv Tower, 43, Nehru Place, New Delhi - 110019, Delhi, India Telephone: +(91)-(11)-46561359, Fax: +(91)-(11)-46561358 Email- info@stpltd.com, hasan@stpltd.com
51.	**SHALIFIX MC** A one part, versatile, pourable, non-shrink, patching / repair compound provides good bond with old concrete. Recommended water and course aggregate are to be added at site as per requirement.	Suitable for use as a topping, patching mortar or repair material on horizontal surfaces	
52.	**SHALIFIX RME** (A three component epoxy based repair mortar of high tensile and high compressive strength provides non-absorbent, non-dusting and chemical resistant surface)	As a repair mortar suitable for industrial shop floors, warehouses, service stations, concrete roads, airport hangers, concrete runways.	
53.	**SHALIPATCH EC 10** (A three component, cold applied, polymerized elastomeric concrete with excellent adhesion)	For crack filling ranging between 5-50 mm wide in concrete/ flexible roads, and surface correction in concrete road/ pavement.	
54.	**SHALIPROTEK 2E HB SF** (A two component pigmented epoxy protective coating provides excellent bond to concrete/metal and good resistance to chemicals/abrasion and fungal & bacterial growth)	Suitable for areas requiring hygienic, dust free and wear-resistant surface and as protective coating in laboratories, chemical/ bottling plant and inside potable water pipeline	
55.	**SHALIPROTEK HR BT 300** (An asphalt based, cold	Internal Casing Surfaces of Furnace & Chimney.	

	applied emulsion for coating Internal Casing Surfaces of Furnace/Boilers Firebrick linings as well as Under Insulation Corrosion Protection for air conditioning pipelines)	External surface of MS pipes over rock wool before aluminium cladding for under insulation corrosion as well as vapour barrier.	
56.	**PERMA R-Poxy** (A two component thixotropic epoxy resin based coloured joint mortar provides resistant to a wide range of spillages and chemical attacks)	For filling joints in between tiles or stones in industrial and residential floors	*PERMA Construction Aids Pvt. Ltd 611/612, Nirmal Corporate Centre, L.B.S. Marg,* *Mulund (W), Mumbai – 400080* *Maharashtra, India* *https://www.permaindia.in*
57.	**PERMA Clear Bond** (A permanent epoxy adhesive of high strength, solvent-less, non shrink & durable provides stress free bond and resistant to chemical attack)	A permanent epoxy adhesive for internal or external bonding tiles, stone, marble, granite etc. with concrete	
58.	**PERMA C-Poxy** (A two component epoxy system for enhancing chemical resistance and strength properties)	Added to enhance the properties of tile adhesives and tile joint fillers	
59.	**PERMA** **Hi Bond Adhesive** (A two component epoxy based bonding agent for binding various materials is chemical resistant and user friendly to use in tanks and pipes)	As a bonding agent for binding various materials such as PVC, EPDM, Rubber, Fibre Glass, polypropylene, etc. to hardened concrete and sealing of construction joints, expansion joints, cracks, etc. pipes, tunnels, concrete tanks, bridge decks, etc.	
60.	**PERMA Master Coat – HD** (A two pack system non-toxic, solvent free, high	As a coating for external and internal protection of concrete or metal tanks, floor &	

	build protective industrial epoxy resin coating is waterproof and chemical resistant)	wall in engineering workshops, and as a decorative coating in laboratories	
61.	**PERMA Master Coat – RI** (A two-pack system non-toxic, solvent free, high build anti-corrosive industrial epoxy coating is waterproof and chemical resistant)	Protection of metals and concrete surfaces which are subjected to aggressive atmosphere	*PERMA Construction Aids Pvt. Ltd 611/612, Nirmal Corporate Centre, L.B.S. Marg, Mulund (W), Mumbai – 400080 Maharashtra, India https://www.permaindia.in*
62.	**PERMA Master Coat – ZN** (Solvent free, anti-corrosive zinc rich heavy duty industrial coating is waterproof and chemical resistant and provides resistance to sea water)	Protection of metal surfaces which are subjected to constant spillage of water and heavy chemical atmosphere and excellent resistance against corrosive gases, sewage gases etc.	
63.	**PERMA Master Prime – CN** (A two component system based on non-solvent epoxy base and epoxy hardener provides effective bond with concrete and resistance to alkalis).	As a primer or bonding agent to the cementitious base for effective bonding	
64.	**PERMA Master Floor – SL** (Three component epoxy resin based mortar of high compressive, flexural and tensile strengths provides Chemical resistant and waterproof).	As a mortar for application to a variety of subfloors as a joint-less, thin, self levelling topping for areas providing seamless, hygienic floor topping in factories, machine shops, hospitals, etc.	
65.	**PERMA Master Patch – FL** (A two component high performance epoxy based resin system of high	Suitable for repairing of concrete, as a bedding mortar for repair of industrial floors, provided that	

	strength, abrasion resistance. It provides excellent chemical resistant to wide range of chemicals, oils, grease, etc.)	quartz silica as specified to make mortar is added at site	
66.	**PERMA EPOXY 100 – EG** (A two component solvent less low viscosity room temperature curing epoxy resin based system)	For injecting into porous concrete to consolidate the structural elements	*PERMA Construction Aids Pvt. Ltd 611/612, Nirmal Corporate Centre, L.B.S. Marg, Mulund (W), Mumbai – 400080 Maharashtra, India https://www.permaindia.in*
67.	**PERMA Heavy Duty Mortar – HDM** (A three component heavy duty epoxy resin mortar for high strength, abrasion resistance. It provides resistant to chemical & aggressive substance)	As a mortar for use in repair of industrial floors, dams, spillways, tunnels, bridge girders, etc	
68.	**PERMA Master Wrap Primer WP – 10** (A two component Non solvent epoxy primer based on epoxy base and epoxy hardener provides effective and easy binding with concrete and resistant to alkalies)	For binding epoxy mortars and flooring products to the concrete base	

14.0 निर्माण उद्योग में इपॉक्सी रेजिन के मुख्य अनुप्रयोग/ Main Application of Epoxy Resin in the Construction Industry

Epoxy resins are widely used in the construction industry in many aspects such as road signs, dam leakage prevention, military engineering emergency maintenance, and plugging.

1. <u>As a bonding material</u> used in building construction, including precast concrete parts and construction bonding such as roof system bonding, column bonding, foundation long pile bonding, girder joint bonding, seismic wall structure partition wall steel bar bonding, internal and

external wall insulation materials, various types of pipeline installation bonding, metal splicing, etc.

2. As a decorative material used for indoor and outdoor decoration and decoration such as external wall mosaic tiles, glass curtain wall installation, indoor ceiling bonding, wallpaper wall covering, floor decoration, floor tile bonding, bathroom waterproof sealing, etc.
3. As a sealant to sealing of various buildings including doors and windows, large slab walls, expansion joints, joints, special constructions, etc.
4. As a structural adhesive extensively used in building maintenance, reconstruction and reinforcement, and many problems that can not be solved by traditional process can be solved.
5. As construction adhesives widely used in reinforcement and maintenance of transportation facilities and water conservancy projects such as highway bridges, highway tunnels, highway pavements; repair of airport runways; repair of railway bridges (reinforced concrete); dam plugging; repairing in water conservancy projects; repairing in traffic, etc.
6. As a bonding material (adhesive) in production of light weight, high strength composite building materials such as manufacture of mobile home components, manufacture of arched roof truss, manufacture of high-strength light weight prefabricated parts, manufacture of resin composite panels, decorative panels, manufacture of synthetic granite, manufacture of various types of artificial panels, and manufacture of composite door and window components for houses, manufacture of various artificial marbles, manufacture of various new construction materials with the use of waste polymer materials, etc. to obtain high-performance, low-cost products.

15.0 क्यों इपॉक्सी विफल हो जाता है - कारण और उपाय/ Why Epoxy gets failed – Causes & Remedy

Causes	Remedy
The trapped debris floors due to poor surface preparation	Always vacuum the floor and shake the dust from the walls. The surface should be clean, dry, dust-free, grinded or shot-blasted.

Wrinkling Epoxy Paint due to humidity	The solvent based epoxy products do not bond well with humidity. The epoxy might dry before the solvent can get out.
The crappy concrete disaster due to weak substrate	If the concrete bed is bad quality due to using low-quality cement, epoxy on top won't fix it.
Using non-paintable sealant due to no primer or wrong primer	Always use suitable primer for industrial floors since floors experience heavy wear and tear
The roller marks	For elimination of roller marks, the area should be back rolled properly.
The pizza leaflet disaster (paw marks)	Seal and block all access to doors & windows.
The PU (Polyurethane) moisture disaster	Polyurethane is very sensitive to moisture and humidity.
The hot weather disaster	Temperature always plays an important role. As temperature increases, a significant amount of the flexural and compressive strength of epoxy decreases and epoxy begins to deform.
The extra B component due to faulty resin/hardener mix	Mix correct and accurate proportions of the components and ensure proper amount of time during mixing.

***

Annexure - I

Chart Showing Details of some of Manufacturing firms& their Products

It shall be ensured by intended user that any advice, specification or information provided here in the table are only for guidance purpose and shall be verified with the manufacture's product specifications before actual use at the site. The information about the manufacturer and their products is based on Internet Search and literature/catalogues as provided by manufacturer or as available on their websites at the time of preparation of this chart. We do not endorse/ or recommend any of the manufacturers and their products to be used at site unless they get listed in approved vendor directory of RDSO.

Users may contact to the manufacturer for getting catalogues for all available products in the market along with technical and price details etc. Here we give the tabulated information about some of the Epoxy Products manufactured/available for applications in repair and rehabilitation of structures.

S. No.	*Product Name*	*Product Description*	*Manufacturer's Specific Remarks and its recommended Dosage /Coverage wherever made available*			
			Coverage/ Dosage	*Shelf Life/ Pot Life*	*Typical Applications*	*Advantages*
1.0	***Cera-Chem Private Limited, No.9, Sterling road, first cross street, Nungambakkam, Chennai-600034, Tamil Nadu. Tel: 044-48684523, Email: corporate@cerachemindia.com***					
1.1	*CERA SCREED EPLV*	*High performance non shrink epoxy grout compatible with all types of concrete, cement based grouts, polymer modified cement system etc.*	• *Coverage – 0.50 Ltr/Kg* • *Packaging – 12 kg packing consisting of Part A-Resin (2.5 Kg), Part B – Hardener (0.5 Kg), Part C – Filler (9Kg).*	• *Shelf life – 12 months in sealed containers under normal conditions.* • *Pot Life – 20 to 30 minutes at 35°C*	*Injection grouting in cracked and porous concrete.*	• *Free flowing, self leveling and non-shrink* • *Pourable and injectable* • *Helps in rapid installation and gains high strength* • *Resistant to acids and alkalis* • *Capable of transmitting high stresses* • *Capable of withstanding*

						repetitive dynamic loading • *High compressive, flexural and tensile strength*
1.2	*CERA SCREED EP*	*Three component epoxy system, when hardened possesses extremely abrasion resistant, chemical resistant as well as exhibits high flexural, compressive and tensile strengths.*	*Coverage –* • *Cera Primer EP - 5 to 6 m^2/kg* • *Cera Screed EP - 13.6 Kg - 1.0m^2 for 6 mm thickness and 1.5 m^2 for 3mm thickness.* • *Packaging – 13.6 Kg Units*	• *Shelf life – Cera Screed EP can be stored for 6 months in sealed packs.*	• *As a floor topping material for industrial floors, workshops, etc* • *As a material used for structural repairs and rehabilitation of corrosion affected structures, dilapidated RCC structures, etc* • *As a repair material for foundation protection, run ways, roads etc*	• *High flexural, compressive and tensile strengths* • *Excellent chemical resistance* • *Impact and abrasion resistant* • *Easy to use*
1.3	*CERA BOND EP*	*Epoxy resin based structural bonding agent compatible with all types of concrete, cement based grouts, polymer modified cement systems etc.*	• *Coverage - 2 - 2.5m^2/kg per coat. The coverage can vary depending on the surface condition.* • *Packaging – 1, 6 Kg ready to use.*	• *Shelf life – 12 months in sealed container if stored below 35^oC.* • *Pot Life – At 35^0C pot life is about 60 minutes.*	• *Useful for bonding fresh concrete/ sprayed concrete/ mortar to old concrete* • *As a repair ingredient to corroded or spalled concrete for horizontal and vertical surfaces.* • *Jacketing applications for strengthening the existing concrete columns, beams, basements etc.* • *As a bonding agent for concrete repairs using cement plaster/screed and for guniting* • *Suitable material for*	*Ideal for structural repairs* • *Monolithic bond* • *Capable of transmitting very high stresses* • *Excellent water & alkali resistance* • *Can be applied on dry as well as damp surfaces* • *Can be cured under moist / wet conditions*

					bonding heterogeneous materials, such as PVC and steel to cement	
1.4	*CERA ZINC ZR*	*Epoxy zinc rich primer –Two-pack polyamide cured air-drying compound having excellent resistance to corrosion and used as as a primer for subsequent coatings in steel structures.*	• *Coverage – 5-6 m^2 per kg /coat. The Coverage may vary depending upon porosity of the substrate.* • *Packaging – 1 and 6 kg*	-	*Used as a coating for protection of reinforcement in concrete, structural steel, M.S. Liners, equipments, conveyors, storage tanks etc., from chemical and saline environments as in Bridges, Culverts, flyovers etc.*	• *Excellent protection for steel from corrosion* • *Recommended for use in natural (coastal) as well as artificial (industrial corroding environments* • *Excellent adhesion and bond strength in Cementitious repair systems* • *Two-component, ready to use system*
2.0	***Choksey Chemical Pvt.Ltd., 111-Industrial Area, Sion, Mumbai-400022. Tel: 022-24090124, E-mail: contact@chokseychem.com***					
2.1	*MASTER-GROUT EP – 150-G*	*Two pack epoxy resin system for injection grouting and for granting gap widths of 0.25 to 10 mm*	• *Coverage – Approx. density 1.08 kg/ltr.* • *Packaging – 1 ltr, 5 ltr, 20 ltr.*	• *Shelf life – One year*	• *Can be applied in crack injection and for filling cold joints* • *For filling base plates and bolt pockets with gaps less than 10 mm* • *Suitable for repairs, rehabilitation of structure showing hairline cracks* • *For filling up cracks in roof slabs & other areas to make them waterproof*	• *Excellent flowability for injection grouting* • *Provides very high early & ultimate strength* • *Good chemical resistance* • *Non-shrink* • *Strong bonding* • *Highest coastal area*
2.2	*MASTER-BOND – EP*	*Two pack epoxy resin bonding agent providing*	• *Coverage – 20-25 sq ft/kg/coat*	• *Shelf life – One year* • *Mixing ratio –*	• *Bonding of old to new concrete* • *Jacketing application for*	• *Excellent adhesive strength* • *It exceeds the tensile strength of concrete*

		strong bond between old concrete and new concrete	*depending ypon the substrate* • *Packaging – 1kg, 5kg, 20kg.*	*Part A: Part B – 65:35*	*vertical & horizontal surfaces where mortar & concrete can be supported by firm work* • *For critical repair & extensions of structural concrete in factories, bridges, concrete structures, etc.*	• *Applicable on dry & damp surfaces* • *High mechanical strength* • *Ready to mix & use at site* • *Gives sufficient pot life* • *Ideal for extension & repair to structural concrete*
2.3	*TECH FLOOR SL -2*	*Self levelling Epoxy floor coating blended of selected epoxy resins, curing agents & graded inert aggregates which when mixed provides a 2 mm thick coating. It provides a hard-wearing attractive floor which is chemical resistant, impervious and extremely clean*	• *Coverage – 0.25-0.30 sqm/kg mix with 2 mm thickness* • *Packaging – 17kg*	• *Shelf life – One year* • *Mixing ratio – Part I: Part II : Part III : Part IV (By Wt.) – 8:5:20:1*	• *For places where high degree of cleanliness & hygiene is required* • *Hospitals, clean rooms, electronic assembly areas*	• *Provides dust free, seamless floor which is extremely easy to clean* • *Good abrasion resistance* • *Excellent chemical resistance* • *As a coating, suitable for concrete and Steel*
3.0	***Krishna Conchem Products Pvt. Ltd. (KCPPL), Building Number 6, Millenium Business Park, MIDC Industrial Area, Sector 3, Kopar Khairane, Navi Mumbai, Maharashtra 400710 Telephone/Fax 022- 2778 29 23 / 24 Email: info@krishnaconchem.com***					
3.1	*EPCO KP/HP-250 SSLV (Slow Setting Low Viscosity Epoxy*	*Slow Setting Low Viscosity Epoxy Injection Grouting System can be used for pressure grouting of*	• *Packaging – 5kg, 100 kg*	• *Shelf life – One year in tightly sealed container* • *Mixing ratio KP-250-SSLV :*	• *For repairs of deteriorated concrete structural elements for strength and durability* • *To create proper bond between separate*	• *Has an excellent bond with the concrete structures.* • *By virtue of its low viscosity, it can penetrate into the finer cracks present in concrete.*

	Injection System)	*concrete surfaces for filling of cracks*		*HP-250-SSLV – 4:1* • *Pot life – 240 minutes at ambient temperature*	*concrete elements* • *Grouting of honeycombs and cavities in concrete structures*	• *As the system is non-shrinking and has excellent bond with concrete, the original strength of concrete is restored.*
3.2	*EPIBOND*	*Bonding New To Old Concrete. Useful for concrete joints for bonding old to new concrete, to be applied by brush over old surface and concreting should be done after coat becomes tacky.*	• *Coverage – 3-5 m^2/litre on level surface* • *Packaging – 2 Lt, 10 Lt, 40 Lt*	• *Shelf life – One year in tightly sealed container* • *Mixing ratio – Base : Curing Agent – 1:1* • *Pot life – 30minutes for 2 Lt mix at 25^{0}C*	• *Concrete jointing (cold joints) and for repairs using cement plaster/ guniting.* • *Reinforcing existing concrete structure or elements and also in jacketing of columns.* • *Waterproof joints (Sandwich Layer).*	• *Excellent bonding agent between New and Old concrete.* • *Provides monolithic bond capable of transmitting high stresses.* • *Possesses excellent water and alkali resistance*
3.3	*EL MONOBOND*	*Two Component Non Re-emulsifiable Epoxy Latex System, which can be used for plain and cement modified coating applications over concrete/plastered substrates..*	• *Coverage – 2-3 m^2/litre of mix (Depending on Substrate)* • *Packaging – 2 Lt, 10 Lt, 60 Lt*	• *Shelf life – 12 months* • *Mixing ratio –* *<u>For Bonding</u>:* *Part A-500ml, Part B- 500ml, Cement-1000ml, Water- 500ml* *<u>For Coating</u>:* *Part A-1000ml, Part B- 1000ml, Cement-3000ml, Water- 2000ml* *For Crack Filling:*	• *Can be applied on Concrete and plain or plastered surface, into wet areas also.* • *Useful for Waterproofing of sunken slabs, basement, roofs etc.* • *Can be used as bonding agent also.*	• *Excellent bonding agent between New and Old concrete* • *Stable, waterproof, impermeable even in presence of water and compatible with cementitious substrate.*

				Part A – 100PBV *Part B – 100PBV* *(PBV-Parts By Volume)* • *Pot life – 1 hr. for 1 Lt mix*		
3.4	*CORROSEAL*	*Two pack polyamide cured air drying epoxy compound applicable for protection of Concrete and Steel Structures.*	• *Coverage – 5-6 m^2/litre/coat on smooth concrete surface 6-7 m^2/litre/coat on steel*	• *Mixing ratio (by volume) – Base: Curing Agent – 1:1* • *Pot life – 45 minutes at 25^0C for 1 Lt mix*	• *Protection of Concrete & Steel structures – Typically Bridge Decks, Piers, Foundations, Marine Structures, Water Retaining Structures, Cooling Towers, Chimneys etc.* • *Protective coatings to Structural Steel, Metal Pipes, Frames, Grills, Tanks, Manhole covers, Drainage systems, M. S. Pile Liners.*	• *Has excellent resistance to corrosion.*
3.5	*IPNET*	*Interpenetrating Polymer Network Concrete Coating System is a novel type of polymer formulation consisting of more than two polymers cross linked in the network form by*	*IPNet (Primer) Base – IP Epoxy Phenolic (Clear)* • *Coverage – 6-8 m^2/litre on concrete surface for DFT- 55-65 microns* • *Packaging- 40 Lt*	• *Shelf life – One year in tightly sealed container* • *Mixing ratio (By vol.) – Base : Curing Agent – 1:1* • *Pot life – 1 hr. for 2 Lt mix*	*Protective coating for concrete Bridges, Bridge Decks, Girders. Pier columns, Parapet, Pipelines and Plant lying in saline atmosphere/ marine environment conditions.*	*As studies conducted by CBRI, Roorkee, the system has excellent Chemical Resistance, Weather Resistance, Tensile Strength, Flexibility, Shear Strength & Hardness Properties as compared to neat epoxy systems.*

		synthesis.	*IPNet (Middle Coat)* *Base – IP Epoxy Phenolic (Pigmented)* • *Coverage – 5-7 m^2/litre on concrete surface for DFT- 90-100 microns* • *Packaging- 40 Lt*	• *Shelf life – One year in tightly sealed container* • *Mixing ratio (By vol.) – Base : Curing Agent – 1:1* • *Pot life – 1 hr. for 2 Lt mix*		
			IPNet (Top Coat) *Base – IP Epoxy Aliphatic Polyurethane (Pigmented)* • *Coverage – 5.5-6.5 m^2/litre on concrete surface for DFT- 40-50 microns* • *Packaging- 40 Lt*	• *Shelf life – One year in tightly sealed container* • *Mixing ratio (By vol.) – Base : Curing Agent – 1:1* • *Pot life – 1 hr. for 2 Lt mix*		
3.6	*WATERSEAL*	*A unique formulation that provides positive waterproofing to the structure. It is a chemically cured epoxy stearate compound of base and curing agent to be mixed in equal proportion by volume prior to*	• *Coverage – 3-4 m^2/kg (on smooth surface)* • *Packaging- 2kg, 40kg*	• *Mixing ratio (By Wt.) – Base : Curing Agent – 1:1* • *Pot life – 30 minutes for 1kg mix*	• *As a Protective Coating to Food Grade Epoxy – Stearate,* • *As a water tight coating to Water Treatment Plants and Hatcheries, and to cure dampness and seepage problems in Basement, Tunnels, Lift wells, Back filled walls or floors and all underground structures.*	• *Impermeable and chemical resistant film on cure.* • *Withstands hydrostatic pressure up to 5kg/cm^2* • *Non-toxic on cure*

		the application.			• *As a dust-proof protective coating on floors and walls in sterile areas and labs.*	
3.7	*ZEROKORR*	*It incorporates specialized polymer having self-healing properties which passiveate pinholes by virtue of redox mechanism.*	-	-	*Self Healing Anti Corrosive Coating System for Structural Steel in industries, power plants, offshore & onshore structures, steel bridges & pipelines*	• *The Zerokarr protects steel by virtue of self healing properties specifically in those areas where pinholes and scratches are occurred.* • *It is far better than epoxies and polyurethane coatings that protect the steel mostly by virtue of being barrier in nature.*
3.8	*GOLDBOND 1893*	*Two part specialty system comprising of a primer part and a saturant part. Primer is comprised of a base and curing agent. Saturant is also comprised of a base and curing agent.*	*Primer Part* • *Coverage – For E-Glass Fiber - 4-6 m^2/kg (on smooth concrete) For Carbon Fiber – 4-6 m^2/kg (on smooth concrete)* • *Packaging- 10kg, 60kg* *Saturant Part* • *Coverage – For E-Glass Fiber - 0.75-1.0 m^2/kg (on smooth concrete) For Carbon Fiber – 1.5-2.0 m^2/kg (on*	*Primer Part* • *Shelf life – 12 months* • *Mixing ratio (By Wt.) – Base : Curing Agent – 1:1* • *Pot life – 45 minutes at 30^0C* *Saturant Part* • *Shelf life – 12 months* • *Mixing ratio (By Wt.) – Base : Curing Agent – 1:1*	*In wrapping of unidirectional e-glass fiber sheets / carbon fiber sheets to concrete structural elements for structural strengthening and seismic retrofitting applications*	*The epoxy binder in the system does withstand upto 70^0C in wrapping application like chimneys*

			smooth concrete) • *Packaging- 10kg, 60kg*	• *Pot life – 45 minutes at 30^0C*		
4.0	***MC-Bauchemie (India) Pvt. Limited, B-501, Shelton Sapphire Building, Sec-15, C.B.D. Belapur, Navi Mumbai 400614 India, Phone: +91-222772856/27570803, +91-2227563867/27563870, E-mail: info-india@mc-bauchemie.in***					
4.1	*MC DUR 1264*	*Low viscosity Epoxy based rigid binding and sealing injection resin*	-	-	• *For use in rigid filling by injection or deep penetration of cracks, joints and voids in building construction, civil and underground engineering structures under dry and wet conditions* • *For filling of injection hoses*	-
4.2	*MC DUR 1200*	*Two component, pigmented epoxy resin coating with increased mechanical and chemical resistance*	-	-	• *Coating of mineral-based substrates in thickness of 1-6 mm* • *Coating of warehouses, production, store rooms, etc.* • *For use in industrial areas or similar* • *Grouting of steel anchors*	-
5.0	***Sunanda Speciality Coatings Pvt. Ltd. Sunshine Tower, 36th Floor, Senapati Bapat Marg, Lower Parel, Mumbai – 400013, India. Tel: +91 2262268000, E-mail-info@sunandaglobal.com***					
5.1	*SUNEPOXY 368*	*Very low viscosity epoxy injection grout material provides structural*	• *Coverage – 5-6 m^2/ltr (on a fairly smooth surface when*	• *Shelf life – 6 months in sealed containers* • *Mixing ratio*	*Used as injection grout to fill cracks and holes*	*Provides structural integrity, High bond strength, good tensile strength, low viscosity and early curing*

		integrity, high bond strength	*applied by spray directly) 6-6.5 m^2/ltr (on a fairly smooth surface when applied by spray directly)* • *Packaging- 1, 5, 20 ltrs HDPE containers*	*(By Vol.) – Base : Hardener – 3:1*		
5.2	*SUNEPOXY 358*	*Two component high viscosity epoxy resin for use in corrosion protection of steel, bond coat for old and new concrete, joints of metals, flooring screed, etc.*	-	• *Mixing ratio (By Vol.) – Base : Hardener – 2:1*	-	• *Tough abrasion, chemical resistant film* • *Excellent adhesion to many surfaces including concrete or metal substrates* • *Formulated specially to provide high chemical resistance*
6.0	***Sika India Pvt. Ltd., 501 & 502, B Wing, Lotus Corporate Park, Off. Western Express Highway, Goregaon East Mumbai – 400063 Tel: +91 2262704038 Fax: +91 2262704039 Email: info.india@in.sika.com***					
6.1(a)	*ICOSIT K25 (I)/3*	*Two part epoxy resin based protective coating for use on concrete, cementitious mortars and rendering, epoxy mortars, steel, stone, wood, etc.*	-	-	-	-

6.1 (b)	*FRIAZINC R*	*Two component, low solvent, zinc rich epoxy resin based primer for steel*	• *Coverage – Part A: 2.37 kg/litre Part B: 0.96 kg/litre Part A+B mixed: 2.20 kg/litre All density values at +27 °C* • *Packaging – Part A 1.88 kg Part B 0.12 kg Part A+B 2.00 kg x 2 sets*	• *Shelf Life – 12 months from date of production* • *Pot life – 2 hours at +30°C (test weight 2 kgs)* • *Mixing ratio – Part A : Part B = 94 : 6 (by weight)*	• *As a protective coating and anti-corrosive primer for steel.* • *Suitable for steel objects which are subjected* • *to mechanical wear, e.g, weirs, interior of pressure pipe line, gates, steel liner of penstocks and tanks, etc.*	• *Excellent corrosion protection* • *Easy to apply* • *Fast application* • *High mechanical properties* • *Good adhesion to substrate* • *Fast drying and curing characteristics* • *Resistance to weathering*
6.2	*HIBOND*	*Epoxy based, two component structural bonding agent*	• *Coverage – 1.68 kg/l at 30ºC when mixed* • *Packaging – 600g System Part A: 400g Part B: 200g*	*12 months from date of production*	*Used as a bonding agent between old and new concrete surfaces during casting of roof slabs, retaining walls, water tanks, extension of balconies, etc.*	• *Long pot life and open time allows sufficient time for placement of new concrete* • *Can be applied on moist surface also* • *Once the two components of the material is mixed the material must be used within approx 4 hours.*
7.0	***CICO Technologies Limited, C-44/2, 1st & 2nd Floor, Okhala Industrial Area, Phase-II, New Delhi, Tel: +91 11-40509400 Email: cicotech@cicogroup.com***					
7.1	*CICO POXY-21LV*	*A two component solvent free, low viscosity, free flowing, and normal curing epoxy resin system consisting of Pack-A (Resin)*	• *Packaging – 15kg & 40 kg*	• *Shelf Life – 24 months* • *Pot life – 45-70 minutes at 30˚C* • *Mixing ratio – Pack A : Pack B*	*As a injection grouting to grout fine cracks, voids and fissures of concrete structures and rocks*	• *Low viscosity and good wetting property facilitate deep penetration in to the structures.* • *Rapid strength gain* • *Unaffected by a wide range of chemicals, oils, etc.*

		and Pack-B (Hardener).		*= 2:1(by weight)*		
7.2	*CICO BOND EPO*	*Two components 100% solid epoxy resin system comprising of Pack-A (Resin) and Pack-B (Hardener).*	• *Coverage – 250-500g /m^2 per coat depending upon the surface porosity, texture and working temperature.* • *Packaging – 0.5kg, 1 kg, 4 kg kit*	• *Shelf Life – 18 months from the date of manufacturing when stored in sealed original packing in cool and dry place* • *Pot life – 30 minutes at 30˚C*	• *Used as a high strength bonding agent for mortars, renders, stone, steel, iron, etc.* • *Applied to both dry and wet surface*	• *Very high mechanical strength* • *Moderate pot life suitable summer as well as winter season* • *Thixotropic- ensures less sagging and positive contact with the substrates* • *Excellent bond strength on dry as well as damp concrete surfaces.* • *No solvent is used therefore no harm to the environment.*
7.3	*CICO POXY SBA*	*Thixotropictwo pack epoxy resin adhesive for segmental bridge construction yielding high strength and available in three grades: Rapid Set (5ºC to 20ºC), Normal Set (15ºC to 35ºC)and Slow Set (25ºC to 45ºC) depending on ambient temperature condition*	• *Coverage – 1.6 kg/mm/m^2* • *Packaging – 1 kg, 4 kg*	• *Shelf Life – 24 months* • *Pot life – 30 minutes at 30˚C*	• *Suitable as bonding medium in the assembly of concrete segmental units and segmental bridge construction* • *Application in crack and surface sealing, concrete repairs-rehabilitation and carbon fiber wrapping for surface reinforcing of distress concrete structures* • *Used for bonding additional reinforcement as structural*	• *Superb adhesion with concrete and many other substrates* • *Easy to mix even at low temperature* • *NON-SAG; suitable for use on dry and damp surfaces.* • *Thick non-drip consistency at high temperature.* • *Non-Shrinking material.* • *Excellent squeezability.* • *High early strength according to the grade used.*

7.4	*CICO POXY TC 200*	*Two component solvent free epoxy coating system for water proofing, dust proofing of concrete walls, floors and ceilings.*	• *Coverage – 8 to 10 m^2/litre per coat (coverage will vary depending on surface conditions)* • *Packaging – 5 kg (Pack – A+B)*	• *Shelf Life – 24 months at ambient temperature and standard storage conditions* • *Pot life – 40 minutes for 1kg massat 30˚C*	• *Protection of atmospherically exposed RCC structures from attack by acid gases, chloride ions, sulphates, oxygen and water* • *Suitable for use on all types of structures, especially those in aggressive marine and coastal environment*	• *Applicable to all types cementitious and mild steel surfaces forming a smooth glossy impervious surface.* • *Excellent abrasion and impact resistance.* • *Excellent resistance to chemical attack including various acids, alkali, organic solvent.*
7.5	*CICO RESIFIX*	*A polyester resin cartridge consists of two components – resin grout and its catalyst*	-	• *Shelf Life – 4 months with specified storage conditions*	*Used for anchoring bolts into rock or concrete for the purpose of mining, tunnelling, etc.*	• *Controlled setting time.* • *Rapid high strength development.* • *Permanent anchorage, unaffected by vibration or corrosive environment.* • *No fire hazards.*
7.6	*CICO GROUT GP*	*An expanding non-ferrous grout, consisting of a dry pre-mixed blend of special grade cement, siliceous aggregate with set regulating and reactive compounds in powder form.*	• *Packaging – 25 kg Polythene Lined waterproof HDPE bags.*	• *Shelf Life – 12 months with specified storage conditions*	• *Grouting of machine bases, column bases (steel and pre-cast concrete) anchor bolts and similar grouting applications.* • *Non-shrink ready to use Cementitious*	• *Controlled expansion, to ensure positive surface contact.* • *No corrosive effect caused by metallic residue.* • *No rusting or staining on exposed edges.* • *Premixed, addition of water only needed.* • *Contains no Calcium Chloride.*
7.7	*CICO TAPECRETE*	*An acrylic based Polymer Modified*	• *Coverage – For a mix*	-	*For surface treatment, protecting, waterproofing*	• *Combines a tough, flexible,*

	P-151	*Cementitious Flexible Composite coating system in conjunction with cement provides properties to improve high adhesion high impact strength, increase flexural strength and thin section fragility.*	*proportion: 2 kg cement: 1 kg TAPECRETE P-151 Polymer* *a) [Cement – 0.5 & P-151 Polymer – 0.25] kg/m^2 for one coat on concrete* *b) [Cement – 0.75 & P-151 Polymer – 0.375] kg/m^2 for two coat on concrete* • *Packaging – 0.5 Kg, 1kg, 5 Kg, 10 Kg, 20 Kg, 50 Kg, 100Kg and 200kg HDPE plastic container*		*and repairing concrete and masonry.* *Protection of concrete against corrosion, salt attack etc.*	*hard-wearing surface with waterproofing.* • *Develops excellent bond to most building materials.* • *Not affected by ultraviolet light or by chemicals ranging from mild acids to strong alkalies.* • *Highly durable in continuous wet condition.* • *Will not rot or corrode.* • *Not harmful to the health of workman.*
7.8	*CICO MICROCRETE*	*A specially prepared ready-to-use grey powder which requires addition of water only at job site. To produce free flowing and semi fluid/plastic high strength concrete which has micro fine aggregate and ability to penetrate*	-	• *Shelf Life – 12 months if kept unopened, sealed condition*	• *For conventional repair of honey combed area and to fill recesses of broken concrete structure* • *For repair and strengthening of concrete beams and columns*	• *Non – shrink* • *High early strength.* • *Excellent bond with parent concrete* • *Protection of reinforcements from corrosion*

		into the recesses of concrete members behind the reinforcement of the structure under repair.				
7.9	*CICOPOXY 215*	*A three component solvent free, free flowing, fast curing epoxy resin system which can be injected/ poured in/on concrete for carrying out structural repairs. The cured resin possesses high mechanical strength, excellent adhesion, non-shrinking properties and a chemical resistance to acids.*	• *Packaging – 8 kg (Pack – A+B+C)*	• *Shelf Life – 24 months in sealed condition* • *Pot life – 45 minutes at 30˚C*	*For repairing of concrete defects on floors, walls and concrete roads.* *For grouting of heavy machine base plates, anchoring of bolts, etc.*	*It possesses* • *high mechanical strength* • *excellent adhesion* • *non-shrinking properties* • *chemical resistance*
8.0	***FAIRMATE Chemical Pvt Limited, 8/1, SAI Sudha, Arunoday Society, Alkapuri, Vadodra- 390007 www.fairmate.com***					
8.1	*FLOWGROUT EPLV*	*Two part, pre formulated, low viscosity epoxy resin*	-	-	*Used for injection of cracks and cold joints in concrete structures. Suitable for damp or dry surface*	-
8.2	*FAIRBOND EP*	*Two pack, solvent free, epoxy based concrete bonding*	• *Coverage – 0.3 kg/m²* • *Packaging –*	• *Shelf Life – 12 months in sealed condition*	*Bonding of old to new concrete*	*Excellent adhesion* *Increases bond strength* *Very good chemical resistance*

		agent	*1 kg & 5 kg*			*Easy to apply*
8.3	*SAFECORE EP (S)*	*High performance solvent based coating with minimum surface preparation*	-	-	*Protective coat on steel provides resistance to mild alkali and acid for steel surfaces*	-
8.4	*SAFECORE EP (F)*	*High build and decorative solvent based chemical resistant coating*	-	-	*Protective coat on concrete for industrial floor and walls*	-
8.5	*ANCHOR GROUT*	*High strength thixotropic, two part polyester resin grout*	-	-	*Suitable for grouting of steel bars, anchoring of bolts into concrete, stones, machinery and brick work*	-
9.0	***Fibrex Construction Chemicals Priva Limited, Building no. 2, Site no-1, Lajwanti Complex, 2 & 3 Floor, Near Metro Pillar No. 562 & 563 14/3 Mathura Road Faridabad, Haryana 121003 Tel: 0129-4081412*** *Email:sales@fibrexchem.com*					
9.1	*FIBPOXY (IR)*	*A 100% reactive, two component material used for Injection grouting*	-	-	*As a moisture insensitive adhesive for numerous injection sealing needs for Permanent bonding of structural damage, Bridge structures, Marine structures, Retaining walls*	• *Excellent adhesive for pressure injection of fine cracks* • *Moisture insensitive for bond on dry or damp surfaces* • *Provides a tough, weather resistant seal for porous concrete*
9.2	*FIBBOND 253*	*Two component epoxy bonding adhesive for concrete*	-	-	-	-
9.3	*FIBMICROCRTE*	*High strength material for use in parking decks,*	-	-	-	-

		floor toppings, joint repairs, equipment bases, pedestals, pavements				
10.0	***STP Limited (Sri Hasan Rizvi, Sr. VP), 707, Chiranjiv Tower, 43, Nehru Place, New Delhi - 110019, Delhi, India Tel: +(91)-(11)-46561359, Fax: +(91)-(11)-46561358, Email- info@stpltd.com, hasan@stpltd.com***					
10.1	*SHALIPOXY CTE A*	*A self priming, two component Coal Tar Epoxy Based Anti-corrosive coating used in corrosive environment*	• *Coverage – 3-3.5 m^2/ltr, DFT 190-225 micron* • *Packaging – 24 Litre packing (Component A – 16 litre + Component B – 8 litre)*	• *Shelf Life – 12 months* • *Pot life – 1 hour at 25°C* • *Mixing ratio – 2:1 by volume*	*Applicable in Tanks, Piping (Concrete, steel), Sheet, pipe Piling, Concrete and Steel surfaces in sewage treatment, Dams, Barrage gates, Penstocks. Foundation walls and sumps, Underground Structures*	• *Possesses exceptional resistance to the effect of water immersion, salt water, oil, acids, alkalies, crude oil, minerals etc.* • *Flexible and affords excellent resistance to impact, thermal shock and abrasion.*
10.2	*SHALIPOXY CTE 303*	*A two component, high build, Anti-corrosive / Protective Flexible Coal Tar Epoxy Coating for steel and concrete giving 300 micron in single coat on wet-on-wet basis*	• *Coverage – 2.5 m^2/ltr (depending upon surface condition), DFT 300 micron* • *Packaging – 20 Litre combo pack*	• *Shelf Life – 12 months from the date of manufacture in original unopened sealed condition* • *Pot life – 4 hours at 30°C*	• *MS / concrete pipes and metallic structures* • *Concrete and Steel surfaces in sewage treatment plant.* • *Foundation walls and sumps*	• *Excellent resistance to impact, thermal shock and abrasion, sea / salt water, oil, acids, alkalis, crude oil and minerals* • *Excellent corrosion / chemical / abrasion / scratch resistance and is used as direct to metal (DTM) application, without any requirement of primer*
10.3	*SHALIFIX EM*	*A 100% solid, solvent free, high performance, non-slumping, three component Epoxy*	*Packaging – 20 kg combo pack resin – 2.9 kg, hardener – 0.5 kg, filler – 16.6 kg*	*Shelf Life – 12 months in original unopened sealed conditions.*	*Car parks and workshops Warehouses. Metal treating plants.*	• *Solvent free, no odour during application* • *Provides non-absorbent, non-dusting, durable, chemical*

		Mortar consisting of an epoxy resin, hardener and selected graded filler, providing a tough and resilient, surface when compared to concrete				*resistant surface.* • *Dries in eight hours to allow foot traffic.* • *High tensile and high compressive strength.* • *Slip resistant - different textures available to suit different conditions.*
10.4	*SHALIBOND CONCRETE*	*A 100 % reactive two component Epoxy Bonding Adhesive/ Primer, solvent free bonding agent for old concrete with new concrete as well as two concrete pre-cast blocks*	• *Coverage – As primer – 200-250 gms/m^2/coat As bonding Agent – 250-300 gms/m^2/ coat, DFT 150-200 micron* • *Packaging – 2 kg x 10 for each of Component A and Component B*	*Mixing Ratio – 2.7 : 1 by weight*	• *Bonding old concrete with new concrete / flooring.* • *Bonding two concrete pre-cast blocks.* • *Priming / Sealing for roads, bridges, pavements, loading bays and factories.* • *Bonding Toppings / Floor and Joint.*	• *Excellent adhesive for bonding together concrete, steel, or wood materials* • *Bonds fresh concrete toppings to harden old concrete slabs.* • *Protects concrete substances against chemical attack including most acids and caustics.* • *May be extended with sand or aggregate for thick applications and mortar repairs.*
10.5	*SHALIGROUT EI*	*A 100% reactive, two component epoxy injection grout for structural strengthening*	• *Packaging – 2 kg x 5 No. Carton*	*Shelf Life – 12 months in original unopened sealed conditions.*	• *As a moisture insensitive adhesive for numerous injection and sealing needs* • *Permanent bonding of structural damage* • *Parking structures* • *Bridge structures, Retaining walls, Earthquake damage*	• *Excellent adhesive for pressure injection of fine cracks* • *Moisture insensitive for bond of dry or damp surfaces* • *Provides a tough, weather resistant seal for porous concrete* • *Penetrates deep into concrete cracks and fissures*

					• *Vertical and overhead applications*	
10.6	*SHALIPRIME 2E SF*	*Two Component transparent, solvent free, Epoxy Primer for Concrete Surfaces including walls, prior to the application of any Epoxy flooring or coating, epoxy repair mortar*	• *Coverage – 5-20 m^2/litre (depending upon surface condition), DFT 50-200 micron* • *Packaging – 4 Litre unit pack consisting of Comp A – 3 litre and Comp B – 1 litre*	• *Shelf Life – 12 months in original unopened sealed conditions.* • *Pot life – 90-120 min at 20°C 60-70 min at 27°C* • *Mixing Ratio – 3: 1 by volume*	• *Used as primer on concrete surface prior to the application of base coat / floor toppings* • *In Traffic deck system for heavy duty traffic* • *Ramps / car parks / parking bays / pedestrian walkways / roof decks* • *Industrial floors, cold stores / warehouses / factories and hangars*	• *Material is 100 % solid and is Solvent Free* • *Facilitates better bonding of Epoxy Floor Topping, Epoxy Screed and Epoxy Mortars with the substrate* • *Prevents air release from the porous substrate, which may otherwise cause bubbles in the final epoxy topping later* • *Seals porous surface to give quality finish*
10.7	*SHALIPRIME ERO*	*Two Component cold cure epoxy based Anti Corrosion Red Oxide Epoxy Primer*	• *Coverage – 6-9 m^2/litre/coat (depending upon surface condition), DFT 35 micron* • *Packaging – 20litre container*	• *Shelf Life – 12 months in original unopened sealed conditions.* • *Pot life – 3-4 hours*	*As anti-corrosive primer on steel surfaces.*	• *Excellent durability to all types of chemical environment. Excellent inter-coat bonding.*
10.8	*SHALISEAL EMS*	*Two Component semi-rigid Epoxy Modified Sealant for filling control and construction joints in industrial concrete floors*	• *Packaging – 2.5 kg Unit contains both hardener and resin packed in 15 kg carton*	• *Shelf Life – 6 months in original unopened sealed conditions.* • *Pot life – 15 minutes at 24°C*	• *Concrete construction and control joints in industrial floors* • *Crack filler repair for old floors*	• *Semi-flexible formula that allows for limited temperature and humidity movement of concrete* • *Tough performance reduces floor joint repairs and maintenance* • *Suitable for filling cracks in older floors to reduce the rate of deterioration*

10.9	*SHALIBOND S*	*Two Component, solvent free, thixotropic, structural adhesive for Segmental Bridge construction conforming to ASTM D 648*	• *Coverage – 2 Litre/m^2at 2 mm (depending upon surface condition)* • *Packaging – 12 kg pack*	• *Shelf Life – 12 months in original unopened sealed conditions.* • *Pot life – 30 minutes at 30°C*	*Segmental bridge adhesive.*	• *High strength and high modulus of elasticity.* • *High initial and ultimate strength.* • *Impermeable to liquid and water vapour.* • *Suitable to dry and damp concrete surfaces (moisture tolerant).* • *Solvent free.* • *Hardens without shrinkage.* • *No primer required.* • *Good chemical resistance.* • *Hardening is not affected by humidity.*
10.10	*SHALIFLOOR TC 2HBE*	*Two Component High Build Epoxy Top Coating with high resistance to abrasion and provides dust free floor surface.*	• *Coverage – 300 gms/m^2in two coats (depending upon surface condition), DFT 200 microns* • *Packaging – 4 kg units packed in 16 kg cartons*	• *Shelf Life – 12 months in original unopened sealed conditions.* • *Pot life – 4 hours at 30°C*	*Area requiring hygienic monolithic floor like operation theatres & corridors in hospitals, computer and control panel rooms, workshops*	• *Prevents bacterial growth* • *Easy to clean* • *Provides smooth monolithic surface when used on metallic surface and simultaneously prevents corrosion*
10.11	*SHALIFLOOR TC 2ARE*	*Two Component, room temperature cured, 100% solid Acid Resistant Epoxy Floor Coating*	• *Coverage – 350-400 gms/m^2in 2 coats (depending upon surface condition), DFT 250-275 microns* • *Packaging – 4 kg units*	• *Shelf Life – 6 months in original unopened sealed conditions.* • *Pot life – 30-45 minutes at 30°C*	• *Protects concrete surfaces from chemical attack.* • *Used around chemical storage tanks and pumps to protect floors.* • *Can be applied over*	• *Easy to apply with a brush or roller* • *Excellent adhesion to concrete surfaces* • *Resists various acids* • *Protects concrete surfaces from chemical attack* • *Provides monolithic surface*

			consisting of components A&B		*metal surfaces subjected to acids and bases.*	*with good aesthetics*
10.12	*SHALIPROTEKNES 70*	*A two component anti-corrosive chemical resistant novolac based phenolic epoxy provides excellent resistance to acid and alkali vapours emanating at high temperature. It bonds well at low temperature & humidity.*	• *Coverage – 8 m^2/litre for DFT 100 microns and 6 m^2/litre for DFT 125microns (depending upon surface condition)* • *Packaging – 20 litre composite pack at the ratio of 3:1*	• *Shelf Life – 12 months in original unopened sealed conditions.* • *Pot life – 1hr at 27°C for 100 gm mix*	*As a coating for concrete flooring exposed to acid / alkali fumes emanating at high temperature, like in Ammonium Sulphate / Annealing / Acid Plants*	• *Excellent resistance to acid and alkali vapours.* • *Low VOC material.* • *Bonds well at low temperature & humidity.* • *Short re-coating time.*
10.13	*SHALIFIX 3EP*	*A three component, non-shrink, epoxy based, putty provides excellent impact resistance, good mechanical and bonding properties*	• *Packaging – 4 kg x 20 nos. pack*	• *Shelf Life – 12 months in original unopened sealed conditions.* • *Pot life – 2hrs. at 30°C*	• *As a protective coating for protection of concrete, steel, marine structure.* • *Sealing of crack for concrete, metal and wooden surface.*	• *Non-Shrink.* • *Excellent impact resistance.* • *Good mechanical properties.* • *Good bonding properties with concrete, Kota stone, steel etc.*
10.14	*SHALIFIX MC*	*A one part, versatile, pourable, non-shrink, patching / repair compound. Recommended water and course aggregate are to*	• *Coverage – 1.5m^2 for 10mm thickness/30 kg bag (water : powder ratio of 0.15 @ 30^{0}C)* • *Packaging – 30 kg bag*	• *Shelf Life – 12 months in original unopened sealed conditions.*	*Repair of damaged concrete structures like columns / beams / slabs etc., Parking decks. Floor toppings, Joint repairs, Equipment bases, Pedestals, Pavements.*	• *Used as a pumpable or pourable repair concrete where access is restricted* • *Compensates for shrinkage by expansion.* • *Premixed, ready to use, having rapid strength development.*

		be added at site as per requirement.				• *Good bond with old concrete.* • *High strengths with low permeability.* • *Chloride free.*
10.15	*SHALIFIX RME*	*A three component epoxy based repair mortar of high tensile and high compressive strength provides non-absorbent, non-dusting and chemical resistant surface*	• *Coverage – 1.9 kg/m²* • *Packaging – 20 kg pack*	• *Shelf Life – 12 months in original unopened sealed conditions.* • *Pot life – 1.5 hr at 30°C*	*As a repair mortar suitable for industrial shop floors, warehouses, service stations, concrete roads, airport hangers, concrete runways.*	• *Provides non-absorbent, non-dusting and chemical resistant surface.* • *Dries in two hours to allow foot traffic.* • *High tensile and high compressive strength.* • *Solvent / VOC free.*
10.16	*SHALIPATCH EC 10*	*A three component, cold applied, polymerized elastomeric concrete with excellent adhesion.*	• *Packaging – Box containing 5 Kg x 2 Packs. Each Pack 5 kg pack consists of Component A (Resin) – 1.8 kg, Component B (Hardener) - 0.45 kg and Component C (Aggregate) – 2.75 Kg.*	• *Shelf Life – 12 months in original unopened sealed conditions.* • *Pot life – 6±1minute at 30°C*	*For crack filling ranging between 5 - 50 mm wide in concrete / flexible roads, and surface correction in concrete road / pavement.*	• *High-load bearing capacity* • *Outstanding anti-spalling properties* • *Tough, Flexible, Durable and Rapid Cure time.* • *Excellent resistance to chemical, saltwater, oil, acids, alkalies, crude oil, fuels and minerals.* • *Compatible with both coal tar and asphalt emulsion-based sealers.* • *Compatible with both concrete and bituminous pavement.* • *Excellent to repair surface defects of the road.*

10.17	*SHALIPROTEK 2E HB SF*	*Two component pigmented Epoxy Protective Coating suitable for areas requiring hygienic, dust free and wear-resistant surface*	• *Coverage – 2.5m²/kg/coat (depending upon surface condition), DFT 250±50 microns* • *Packaging – 16 kg carton (4 kg x 4 nos.) consisting of components A&B*	• *Shelf Life – 12 months in original unopened sealed conditions.* • *Pot life – 40 minutes at 30°C*	*Suitable for areas requiring hygienic, dust free and wear-resistant surface and as protective coating in laboratories, chemical/ bottling plant and inside potable water pipeline*	• *Easy to apply.* • *Excellent bond to concrete / metal.* • *Good resistance to chemicals / abrasion*
10.18	*SHALIPROTEK HR BT 300*	*An asphalt based, cold applied emulsion for coating Internal Casing Surfaces of Furnace / Boilers Firebrick linings as well as Under Insulation Corrosion Protection for air conditioning pipelines*	• *Coverage – 2.6 kg/m² (depending upon surface condition), DFT - 1 mm* • *Packaging – 20 kg container*	• *Shelf Life – 06 months in original unopened sealed conditions.*	• *Internal Casing Surfaces of Furnace & Chimney.* • *External surface of MS pipes over rock wool before aluminium cladding for under insulation corrosion as well as vapour barrier.*	• *Protects inner vessel casings from corrosive chemical thus avoiding deterioration. Excellent moisture barriers.* • *High Temperature resistance.* • *Retains thermal efficiency during all weather conditions.* • *Effective insulation material.* • *Solvent free and hence eco-friendly and non-toxic.* • *Effective Under Insulation Corrosion Resistance.*
11.0	***PERMA Construction Aids Pvt. Ltd 611/612, Nirmal Corporate Centre, L.B.S. Marg, Mulund (W), Mumbai – 400080 Maharashtra, India https://www.permaindia.in***					
11.1	*PERMA R-Poxy*	*A two component thixotropic epoxy resin based coloured joint mortar*	• *Coverage – 20 sqft per kg for joint width of 8 mm and for tile size 12"x12"* • *Packaging –*	• *Shelf Life – 6 months from date of manufacture* • *Pot life – 60 minutes at*	*Used for filling joints in between tiles or stones in industrial and residential floors*	• *Provides resistant to a wide range of spillages and chemical attacks* • *Provides for aesthetic germ proof, chemical and hard wearing joints*

			1 kg & 5 kg pack size	*25°C* • *Mixing Ratio – 2: 1 by weight*		
11.2	*PERMA Clear Bond*	*A permanent epoxy adhesive for internal or external bonding tiles, stone, marble, granite etc. with concrete*	• *Coverage – 30 to 40 sqft per kg* • *Packaging – 1 kg pack*	• *Shelf Life – 12 months from date of manufacture* • *Pot life – 35 to 40 minutes at 30°C* • *Mixing Ratio – 2: 1 by volume*	• *Applied to clean, sound and durable surfaces, i.e. glazed tiles and bricks, ceramic and quarry tiles, terrazzo tiles and floors, old and worn concrete, marble, granite, etc* • *Used for surface grouting of porous marble and granite before polishing*	• *High strength* • *Non shrink* • *Durable* • *Resistant to chemical attack* • *Solventless epoxy* • *Provides an even and stress free bond*
11.3	*PERMA C-Poxy*	*A two component epoxy system for enhancing the properties of tile adhesives and tile joint fillers*	• *Coverage – 600 gms per kg or as per specifications of tile adhesive manufacturers* • *Packaging – 300 gms, 600 gms and 1.5 kg*	• *Shelf Life – 12 months if stored in manufacturer's original packing*	*Added to tile joint fillers to increase chemical resistance and mechanical properties in tiling jobs*	*Enhances the chemical resistance and strength properties*

11.4	*PERMA Hi Bond Adhesive*	*A two component epoxy based bonding agent for binding various materials such as PVC, EPDM, Rubber, Fibre Glass, polypropylene, etc. to hardened concrete*	• *Coverage – 6 sqft per kg if applied in a thickness of 1 mm and about 3 sqft per kg if applied to a thickness of 2 mm* • *Packaging – 1 kg*	• *Shelf Life – 12 months if stored in cool & dry conditions* • *Pot life – 45 minutes at 25°C* • *Mixing Ratio – 1: 1 by weight*	• *Useful in sealing of construction joints, expansion joints, cracks, gaps and crevices with desired materials such as rubberised sheets* • *Useful in sealing joints in pipes, tunnels, concrete tanks, bridge decks, water detailing in corners and edges of bathrooms and toilets, etc.*	• *Root resistant and chemical resistant* • *Applied horizontally, vertically or in overhead applications* • *User friendly and easy to apply* • *Used in tanks and pipes*
11.5	*PERMA Master Coat – HD*	*A two pack system non-toxic, solvent free, high build protective industrial epoxy resin coating based on epoxy resin and hardener.*	• *Coverage – 3 to 4 sqm per kg per coat* • *Packaging – 1 kg consisting of two component*	• *Shelf Life – 12 months from the date of manufacturer* • *Pot life – 45 minutes at 35°C*	• *Used for external and internal protection of concrete or metal tanks* • *Used as floor and wall coating in engineering workshops* • *Used as a protective and decorative coating in laboratories*	• *Durable, solvent free, non-toxic, high build coating* • *Waterproof, chemical resistant* • *Easy applied by brush or roller*
11.6	*PERMA Master Coat – RI*	*A two-pack system non-toxic, solvent free, high build anti-corrosive industrial epoxy coating based on epoxy resin and hardener.*	• *Coverage – 3 to 4 sqm per kg per coat* • *Packaging – 1 kg and 40 kg*	• *Shelf Life – 12 months from the date of manufacturer* • *Pot life – 45 minutes at 35°C*	*Used as an anti corrosive protective coating to metals and concrete surfaces which are subjected to aggressive atmosphere*	• *Durable, solvent free, non-toxic, high build coating* • *Waterproof, chemical resistant* • *Easily applied* • *Anti corrosive*
11.7	*PERMA Master Coat*	*Solvent free, anti-corrosive zinc rich*	• *Coverage – 3 to 4 sqm per kg*	• *Shelf Life – 12 months from*	• *Used for protection of metal surfaces which*	• *Durable, solvent free, non-toxic*

	– ZN	*heavy duty industrial coating, based on epoxy resin and hardener.*	*per coat* • *Packaging – 1 kg and 40 kg*	*the date of manufacturer* • *Pot life – 45 minutes at 35°C*	*are subjected to constant spillage of water and heavy chemical atmosphere* • *Used for excellent resistance against corrosive gases, sewage gases etc.*	• *Waterproof, chemical resistant* • *Easily applied* • *Anti corrosive* • *Resistant to sea water*
11.8	*PERMA Master Prime – CN*	*A two component system based on non-solvent epoxy base and epoxy hardener*	• *Coverage – 3 to 4 sqm per kg* • *Packaging – 1 kg*	• *Shelf Life – 12 months from the date of manufacturer* • *Pot life – Approx 1 hour at 25°C*	*Used as a primer or bonding agent to the cementitious base for effective bonding*	• *Effective bond with concrete* • *Resistant to alkalis* • *Being moisture tolerant makes priming easy*
11.9	*PERMA Master Floor – SL*	*Three component epoxy resin based mortar*	• *Coverage – 2 to 4 sqft per kg at 3 to 1.5 mm thickness* • *Packaging – 5 kg*	• *Shelf Life – 12 months from the date of manufacturer* • *Pot life – 45 minutes at 25°C*	• *Used for Aesthetic self levelling epoxy flooring* • *Applied to a variety of subfloors providing seamless, hygienic, self-levelling floor topping in factories, machine shops, hospitals, etc*	• *High compressive, flexural and tensile strengths in excess of concrete* • *Chemical resistant and waterproof* • *Hygienic and non-dusting* • *Easy to use, easy to clean*
11.10	*PERMA Master Patch – FL*	*A two component high performance epoxy based resin system consisting of epoxy base and hardener which needs on site addition of quartz sand as specified*	• *Coverage – 3.75 sqft per kg mixed with 5.7 kg of quartz sand for 1 cm deep repair area, whereas 1 kg of base & reactor mixed with 2 kg of ball mill powder*	*Shelf Life – 12 months if stored in manufacturer's original packing*	*Used for heavy duty industrial floors repairs*	• *Abrasion resistant and hard wearing* • *Slip resistant* • *High strength* • *Excellent chemical resistant to wide range of chemicals, oils, grease, etc*

		to make a mortar	*covers 20 sqft.* • *Packaging – 1 kg*			
11.11	*PERMA Epoxy 100 – EG*	*A two component solvent less low viscosity room temperature curing epoxy resin based system*	*Packaging – 1 kg & 40 Kg*	• *Shelf Life – 12 months from the date of manufacturer* • *Pot life – 60 minutes at 27°C* • *Mixing Ratio – Part A – 650 gms Part B – 350 gms (by weight)*	• *Used for injecting into porous concrete to consolidate all loose particles* • *Used for consolidating concrete mass in weak concrete structures* • *Used for preventing water contact of reinforcement in structures* • *Used for waterproofing leaky, porous concrete structures*	• *Free flowing due to low viscosity* • *Fast setting minimising bleeding wastages*
11.12	*PERMA Heavy Duty Mortar – HDM*	*A three component heavy duty epoxy resin mortar*	• *Coverage – 5.4 sqft per kg per mm thickness of screed* • *Packaging – 10 kg*	*Shelf Life – 12 months from the date of manufacturer* • *Pot life – 20 minutes at 30°C*	*Used for repair of industrial floors and heavy duty repairs of dams, tunnels and bridges, etc*	• *Abrasion resistant and hard wearing* • *Slip resistant up to 20 mm* • *High strength* • *Easy to handle* • *Resistant to chemical and aggressive substance*
11.13	*PERMA Master Wrap Primer WP – 10*	*A two component Non solvent epoxy primer based on epoxy base and epoxy hardener*	• *Coverage – 3.4 sqm per kg* • *Packaging – 1 kg*	*Shelf Life – 12 months from the date of manufacturer*	*Used for binding epoxy mortars and flooring products to the concrete base taking care of porosity of base and mobilising particles of mortar into crevices and holes of concrete surfaces*	• *Effective and easy binding with concrete* • *Being moisture tolerant makes priming easy* • *Resistant to alkalis*

सन्दर्भ
REFERENCES

S. No.	Description
1.	**Indian Railway Bridge Manual (Edition 1998)**
2.	**A & C slip no. 5, dated 30.08.2013 (IRS:B1-2001),** issued by B & S Directorate, RDSO, Lucknow**.**
3.	**Epoxy Resin** Source: www.home.engineering.iastate.edu
4.	**Course No. 714 on "Rehabilitation of Grooved PRC Sleepers by Epoxy treatment in sharp curves more than 6 degrees"** Source: www.wiki.iricen.gov.in
5.	**CE's Circular No.198 (South Eastern Railway) on "Painting of Rail & Weld Collar"** Source: www.ser.indianrailways.gov.in
6.	**Chapter-5 – Maintenance and Rehabilitation [Guidelines for Inspection, Maintenance and Rehabilitation of Concrete bridges]** Source: www.wiki.iricen.gov.in
7.	**Epoxy Resin Systems – Hazard Evaluation System and Inspection Service** Source: www.cdph.ca.gov
8.	**Chapter-5 – Selection of Repair Materials for Concrete** Source: 'Handbook on Repair and Rehabilitation of RCC Buildings', published by Director General (Works), CPWD, Govt. of India, Nirman Bhavan.
9.	**Field Guide to Concrete Repair application procedures [Structural Crack Repair by Epoxy Injection]** Source: www.concrete.org
10.	**Three Bond Technical News (Tech 19 & Tech 32)** Source: www.threebond.co.jp
11.	**Epoxy Resins – Solution to Structural Repairs and Rehabilitation problems in Civil Engineering** Source: International Symposium on Innovative World of Concrete (ICI-IWC-93), Vol., organized by Indian Concrete Institute (Karnataka centre)
12.	**Internet Search**
13.	**Product Manufacturers' websites**

NOTES

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	

गुणवत्ता नीति

आर. डी. एस. ओ. लखनऊ में हम सतत सुधार और ग्राहक मूल्यांकन प्राप्त करने हेतु गुणवत्ता प्रबंध प्रणालियों की आवधिक समीक्षा के माध्यम से रेलों में यात्री और माल यातायात की बढ़ती आवश्यकताओं, माँग और अपेक्षाओं को पूरा करने के लिए गुणवत्ता प्रबंध प्रणाली की व्यवहारिक आवश्यकताओं और अनवरत सुधारों को पूरा करने के समर्पण गुणवत्ता उद्देश्यों को निर्धारित करके अनुसंधान, अभिकल्पों और मानकों में उत्कृष्टता के माध्यम से वैधानिक और नियामक अपेक्षाओं का अनुपालन करते हुए सुरक्षित, आधुनिक और किफ़ायती रेल प्रौद्योगिकी विकसित करने हेतु सेवाओं को बनाए रखने और अद्यतन पारदर्शी मानकों हेतु प्रतिबद्ध हैं। इसे संगठन के अंदर संसूचित एवं लागू किया गया है तथा सभी संबंधित पक्षकारों को भी उपलब्ध कराया गया है।

QUALITY POLICY

"We at RDSO Lucknow are committed to maintain and update transparent standards of services to develop safe, modern and cost effective railway technology complying with statutory and regulatory requirements, through excellence in research, designs and standards by setting quality objectives, commitment to satisfy applicable requirements and continual improvements of the quality management system to cater to growing needs, demand and expectations of passenger and freight traffic on the railways through periodic review of quality management systems to achieve continual improvement and customer appreciation. It is communicated and applied within the organization and making it available to all the relevant interested parties."

डिस्क्लेमर / **Disclaimer:** *The document prepared by CAMTECH is meant for the dissemination of the knowledge/ information mentioned herein to the field staff of Indian Railways. The contents of this handbook/booklet are only for guidance and not statutory. Most of the data & information contained herein in the form of numerical values are indicative and based on the tests/trials conducted by various agencies generally believed to be reliable. While reasonable care and effort has been taken to ensure that information given is at the time believed to be fare and correct and opinion based thereupon are reasonable. Due to very nature of research it can not be represented that it is accurate or complete and it should not be relied upon as such. The reader/user is supposed to refer the relevant codes/ manuals available on the subject before actual implementation in the field.*

हमारा उद्देश्य

अनुरक्षण प्रौद्यौगिकी और कार्यप्रणाली को उन्नयन करना तथा उत्पादकता और रेल्वे की परिसम्पत्ति एवं जनशक्ति के निष्पादन में सुधार करना जिससे अन्तर्विषयों में विश्वसनीयता, उपयोगिता और दक्षता प्राप्त की जा सके।

यदि आप इस सन्दर्भ में कोई विचार और सुझाव देना चाहते हों तो कृपया हमें इस पते पर लिखें।

सम्पर्क सूत्र	:	निदेशक (सिविल)
पत्राचार का पता	:	भारतीय रेल उच्च अनुरक्षण प्रौद्योगिकी केन्द्र, महाराजपुर, ग्वालियर (म.प्र.) पिनकोड - 474005
टेलीफोन	:	0751–2470869
फैक्स	:	0751–2470841
ई–मेल	:	dircivilcamtech@gmail.com

OUR OBJECTIVE

To upgrade Maintenance Technologies and Methodologies and achieve improvement in Productivity and Performance of all Railway assets and manpower which inter-alia would cover Reliability, Availability and Utilisation.

If you have any suggestion & any specific comments, please write to us:

Contact person	**:**	**Director (Civil)**
Postal Address	**:**	**Indian Railway Centre for Advanced Maintenance Technology, Maharajpur, Gwalior (M.P.) Pin Code – 474 005**
Phone	**:**	**0751 - 2470869**
Fax	**:**	**0751 – 2470841**
E-mail	**:**	**dircivilcamtech@gmail.com**