

What is unique about the *pcw* – permanent carbon wrap ?

pcw were developed in close cooperation with pipeline – operator technicians for pipeline operators, to cover all demands of longlasting pipeline integrity

pcw is the only durable compound pipeline repair system worldwide, certified for a lifetime of more than 100 years.

pcw is the only pipeline repair system of which the elastic modulus is higher than the one of steel

pcw is the only pipeline repair system which supports defects in a way, that tensile stress in the defect is at no time higher than the one of undamaged pipe.

By which technical standards are *pcw* covered ?

pcw are certified as durable – lifetime > 100 years – pipeline repair system according to “VDTÜV - Merkblatt 1070” of German TÜV’s and meets the requirements of DIN ISO/TS 24 817 and ASME PCC-2 standards.

What is the attestation of the “VD TÜV Merkblatt 1070” ?

The content of the “VD TÜV Merkblatt 1070” was issued by all German TÜV’s to have a standard procedure how to deal with compound pipeline repairs.

Where are the certificates valid ?

The “VD TÜV Merkblatt” is valid in all countries, where services of German TÜV’s are accepted. DIN ISO/TS 24 817 and ASME PCC-2 standards are valid worldwide.

What kind of pipeline defects can be repaired with *pcw* ?

All kind of pipeline defects like corrosion, dents, cracks, welding defects, laminations, where tightness of the pipe can be secured, can be repaired with *pcw*

Are there pressure limitations for *pcw* utilization ?

No, there are no limits as *pcw* are calculated for each defect in particular and the number of necessary layers id adjusted to pressure conditions.

What is the max. axial length of defects to be repaired with *pcw* ?

There is no limitation in repairable defect lengths.

Is repair of spirally welded pipes possible ?

Yes, there are two possibilities: If possible, the welds are grinded plain to pipe surface, if not they are covered with filler to get a plain contact area for the **pcw**.

How are longitudinal and girth welds treated for application?

They are treated adequate to spiral welds.

What is the influence of grinding of weld to the strength of the pipe ?

There is no influence to the strength of the pipes, as the overhang of the weld does not support the strength of the weld in any way.

If grinding of welds could lead to a leakage, the weld has to be covered by filler and then supported by a **pcw**

Repair of dents ?

Yes - dents are supported by **pcw** in a way, that “breathing” of dents and with it forming of cracks is avoided.

Repair of laminations ?

Yes – laminations can be treated like metal losses and **pcw** are calculated in relation to reduction of MAOP caused by lamination.

Repair of bends ?

Yes, but only if supporting of defect can be realized by small stripes of **pcw**, at which the gap between bend and wrap has to be equalized to get a plain contact area.

Full covering of bends is not possible, as for sufficient supporting of defects, the carbon wraps must be very stiff, which in return avoids the possibility of wrapping over bends.

Repair of shaped parts (e.g. tees) ?

Due to the extreme stiffness of **pcw** generally not possible

What is the resistance of **pcw** against mechanical deformation ?

For supporting the defect in circumferential direction **pcw** have a higher strength than the pipe itself. Support against bending and additional axial loads is not given.

Why are *pcw* made for a lifetime of 100 years – lifetime of pipelines is much shorter?

Due to improved inspection methods and consequential look after integrity, lifetime of pipelines is increasing steadily. Once repaired, in our opinion a defect should not cause any more problems within the lifetime of the pipeline.

Chemical resistance of *pcw* ?

pcw are resistant against :

acids	ph-value > 3
leaches	ph-value < 13

pcw are not resistant against :

- benzol
- temperatures > 80°C (in standard configuration)
- UV – radiation

Ageing resistance of *pcw* ?

Ageing resistance of *pcw* was tested and fatigue lifetime extrapolated by TÜV – Süd (Germany). The resin is solvent- and diluent free by what no brittleness occurs and adhesive bonding is conserved.

Bonding problems of *pcw* due to load cycles ?

There are no bonding problems of *pcw* given. On one test stand wraps were applied at a pipe pressure of 32 bars. After 100.000 load cycles from zero to full MAOP, adhesive bonding was still > 10 N/mm².

Bonding problems of *pcw* due to environmental influences ?

Above ground pipelines have to be covered with UV – protection – e.g. polyurethane coating. For buried pipelines we recommend appropriate isolation against mechanical damage (during trench filling) or disturbance by “aggressive solids”.

Condition of filler, due to load cycles ?

Even after 100.000 load cycles from zero to max. MAOP, the filler did not show any variation like shrinking or cracks.

What is the necessary surface preparation ?

Surface must either be sandblasted or mechanically cleaned by slowly rotating grinding devices.

Required preparation grade:

sandblasting: SA 3; roughness > 60 µm

mechanic: St 3; roughness > 60 µm

Is application of *pcw* possible on wet surfaces ?

Yes - our resin was especially developed for extreme application conditions like wet surfaces, high humidity, low / high temperatures.

Who executes the *pcw* application ?

Normally application is executed by our technicians. In case of interest training of customers staff is possible, either at our partner in Austria or during application on site.

Successfully completed training will be documented by issuing of a certificate, which is then valid for one year and extended by executed applications.

What is the average time for *pcw* application ?

A big advantage of our *pcw* repair system is the short repair- and curing time, till full loading capacity.

Depending on the size of the wrap the repair time varies from app. One hour up to several hours. Curing time depends on surrounding temperature and is app. 3 hours – full load is possible, when hardness of resin has reached 50 shore D.

At what pipeline pressure can *pcw* be applied ?

In any case pipeline pressure has to be lower than max. allowable pressure of the defect ! The application pressure is one of the main factors for calculation of necessary layers of and must be indicated within the inquiry.

The lower the pipeline pressure during application, the lower the number of necessary layers of *pcw*.

How long must the pipeline pressure be reduced ?

Pipeline pressure must be reduced only for application of itself and for duration of resin curing. Preparation works (grinding, application of filler and Primer) can be executed at normal operation pressure.

What is the necessary space in the trench for *pcw* application

Normally 0,5 meters around the pipe are required for application with winding device. In exceptional cases application must be executed without winder the min. space is then 0,15 meters.

What treatment of *pcw* is necessary after application ?

Above ground pipelines have to be covered with UV – protection – e.g. polyurethane coating. For buried pipelines we recommend appropriate isolation against mechanical damage (during trench filling) or disturbance by “aggressive solids”.

Are *pcw* detectable by future intelligent pig runs ?

Repaired defects will be shown like in previous pig runs – the PCW itself will not be indicated. Pipeline repairs are normally documented in pipeline integrity management systems of pipeline operators. On request *pcw* can be made detectable for intelligent pigs on magnetic flux basis.

What subsequent tests of *pcw* are required ?

According to available certificates no subsequent test are necessary if application was executed according *pcw* application manual and site protocol, countersigned by customer and application company, is available.

What references do you have for *pcw* ?

Previous customers are listed in our reference list (see homepage www.pipeandlines.com)