TANK SUPPORTS FOR TANKERS CARRYING HEATED BULK LIQUIDS IN INDEPENDENT TANK CONSTRUCTIONS

SUCCESSFULLY TESTED ON CARRYING LOADS UP TO 98 TONS AT MAXIMUM CARGO TEMPERATURES UP TO 250 °C
BV CERTIFICATES 08318/B0 AND 14127/A0
THE OPTIMUM SOLUTION FOR:

- CARRYING HIGH LOADS UNDER EXTREMELY HIGH TEMPERATURES
- ABSORBING CONSTRUCTIONAL TOLERANCES
- ALLOWING MOVEMENT BY OPTIMIZED COEFFICIENT OF FRICTION
- REDUCING TEMPERATURES

BEELE ENGINEERING BY
CSD INTERNATIONAL BY

BEELE Engineering and CSD International have been working in the field of water and gas tight and fireproof sealing of conduits for pipes and cables for more than 35 years. In the field of passive fire prevention, we have invested substantial amounts of money in the development of systems which are capable withstanding fires for extended periods of time. Passive fire prevention is a very complicated matter due to the fact that cable and pipe penetrations have to be designed to the actual circumstances at site and not for a laboratory test. In case of a catastrophe penetrations are subject not only to flame erosion and very high temperatures, but also to mechanical loads due to collapsing cableways and possibly a jet of fire-fighting water. This means that the performance in actual situations can differ dramatically from that in a regular fire test. In fact, the systems could only be applied as tested to guarantee the required fire safety.

And this means discussions and limitations!
We have ensured that our systems will function under all circumstances, and the classification societies have awarded us signed and stamped installation drawings of our sealing systems. Approved for steel and aluminium partitions. Guaranteed safety in your installation will be the result.

The R&D department of BEELE Engineering is constantly working in the field of rubber and systems techniques to optimize the existing systems and to develop new concepts for cable and pipe conduits on board of vessels and offshore installations. Although installation of the CSD sealing systems is in fact an easy matter, a full training programme can be given in-house by our engineers. Because the advantages and possibilities of passive fire prevention and evacuation signposting can most effectively be discovered in an environment that matches the practical situation as closely as possible, we have constructed an unique research and development centre. As far as is known, this R&D centre is the only institute world-wide where visitors can experience for themselves all the aspects of fire prevention and evacuation signposting systems.
TRANSPORT OF HEATED LIQUIDS

In the past it was common practice to make use of single-hull carriers with integrated cargo tanks for sea transport of heated bulk liquids. Even before the safety requirements for carriers in general were increased, the need arose for independent tanks. This demand was evoked by the increasing temperatures at which the cargoes like asphalt, coal tar or creosote were loaded and transported. In the early years of sea transport of heated cargoes, temperatures of about 90 °C were already high, but nowadays temperatures in the range of 200 °C to 250 °C are nothing unusual anymore. In these cases the thermal expansion and contraction may well cause the yield stress to be locally exceeded in the structure due to the enormous temperature differences between the cargo load and the seawater. This phenomenon has led to frequent fractures of the structure in carriers with integrated cargo tanks and the resulting maintenance costs are very high. The only way to avoid fracturing of the structure is to use independent cargo tanks.

GENERAL DESIGN CRITERIA

Independent tanks must be capable of expanding freely, and no uncontrolled forces caused by thermal expansion may be transferred to the ship’s structure. All parts fixed to the tank must be insulated. Criteria for the design of the insulation are the temperature levels of the cargo and the allowed temperatures outside the cargo tanks.

Attention has to be paid to minimize heat transmission through the tank bottom stiffeners and the tank supports. It will be clear that hot-spots in these areas are unacceptable because thermal stresses and cracks will be a potential source of serious failures. The forces of the load of the tank on the tank supports should be uniformly distributed.

TANK SUPPORTS

The tank supports of independent cargo tanks have to absorb the temperature difference between the cargo load (tank) and the seawater. Furthermore the supports have to control the expansion of the cargo tank and support the load. Also the forces generated by the movement of the vessel have to be absorbed by the tank supports. For this purpose BEELE Engineering has developed the ULEPSI tank supports. They consist of a plate of a ULEPSI-G glassfilled rigid plastic measuring 200x200 mm which is capable of carrying a load of 320 kN (350x350 mm 980 kN) at a temperature of 175 °C. Underneath the rigid plate, a ULEPSI-S plate of a red-brown highly heat resistant rubber is placed to bring the temperature down to about 100 °C.

A plate of a ULEPSI-E black rubber with outstanding mechanical properties, which is placed underneath the ULEPSI-S plate, will reduce the temperature further to below 70 °C. In this simple way the problems with thermal stress in the structure are a thing of the past. From practical installations which have been in use now for more than fifteen years in several bitumen carriers it has been proved that the ULEPSI tank supports are really maintenance free. Maintenance costs on the structure of the tank have also been reduced substantially. Bureau Veritas has issued a Type Approval Certificates on the ULEPSI tank supports. Certificate 08318/B0 BV for the ULEPSI 200x200 and certificate 14127/A0 BV for the ULEPSI 350x350 tank supports.
The latest versions of the ULEPSI tank support system developed by the yards have a levelling plate included to compensate for irregularities in the tank beam construction. Since milling these plates to adjust for the angle differences between the tank support and the beam of the tank is a labour intensive (and therefore costly) job, the ULEPSI tank supports have been officially tested under an angle of 3.90° (15 mm displacement over 200 mm). The test results show that the levelling plate is tilted under the angled load whereby the rubber plates more or less “flow” into the open spaces occurring under the tilted top plates. In this way the rubber filling stabilizes the levelling and ULEPSI plate underneath. No damage occurred either to the ULEPSI-G or to the ULEPSI-S and -E rubber plates. The dimensional tolerances of the casing and the levelling plate are a determining factor in this respect. Based on the outcome of the test it has been proven that the tank support itself adjusts for angle differences. We refer to TNO report 43/04.012357/sec dated October 12, 2004.

Note: optimum sliding capacities underneath the beam of the tank; optimum mechanical stability of the milled casing. No sliding steel to steel.
Type Approval Certificates on the ULEPSI tank supports have been issued by Bureau Veritas. The ULEPSI supports 200x200 are approved for loads up to 32 tons (320 kN); the ULEPSI supports 350x350 up to 98 tons (980 kN) both for cargo temperatures up to 250 °C.

Quality System Approval SMS.W.I.C.E.D/2357/A.0 and ISO 9001:2001 Certificate NL7001684 issued by Bureau Veritas

ULEPSI tank supports are a proven system in practice for almost 20 years. The high quality materials used for the system guarantee a long term service life. Engineered rubber technology based on the bulk modulus of rubber allows very high loads and adjustment in case of tolerances.
A 400 tons press is used for testing the ULEPSI tank support under heat and mechanical load. The data are recorded via a data logger and stored in a computer. All testing with the ULEPSI tank supports are witnessed by Bureau Veritas and carried out by TNO Industry.

After exposure to 150 tonnes for one hour at 175 °C the status of the tank support is checked. The ULEPSI-G, ULEPSI-S and ULEPSI-E plates are inspected for possible damage. The ULEPSI 200x200 has even been subjected to 195 °C thermal load without showing any damage.
In consultation with Bureau Veritas a further test was carried out to determine the tolerances when the tank support is exposed to a mechanical load under an angle. The left side of the tank support is positioned 10 mm higher than the right side. For this purpose an adjustment plate has been placed underneath the steel casing.

The press is closed at full load to see how the ULEPSI tank support would adjust itself. It is visible that the steel levelling plate is lifted at the right side. The rubbers underneath the ULEPSI-G plate fill up any void spaces by tilting of the steel and ULEPSI-G plate. High-tech by BEELE Engineering.
The ULEPSI tank support system is engineered on the basis of the bulk modulus of the used rubber plates. To obtain optimum performance it is very important that not only the dimensions of the steel casing, but also those of the used ULEPSI plates are within the specified tolerances. For this reason the rubber grades have to be of high quality. Since the casings and the levelling plates are generally manufactured by the yard, we have set the following dimensions: for the steel casing the inner dimensions are 200x200 mm with tolerances +1.5/+0.5 mm; the outer dimensions of the steel levelling plate are 199x199 mm with tolerances +0.5/-0 mm. For the 350x350 series the respective dimensions are 350x350 mm with tolerances +1.5/+0.5 mm for the casing and 349x349 mm with tolerances +0.5/-0 mm for the levelling plate. Due to the almost exact fit of the rubber plates inside the steel casing it is advisable to drill a small hole in the bottom of the steel casing to let the air out when inserting the rubber plates.
There are two versions possible for the casings for ULEPSI tank support system. The initially used version is a construction of flat steel bars welded together. The casings are generally made by the yard. Caution has to be taken that the welding of the flat bars is of high quality so that no cracks will occur even when loads up to 1500 kN are applied to the tank support system. This high load is a safety factor and is generally used for testing to obtain Type Approval Certificates. Also the flat bars should be stiff enough to avoid bending under load. Furthermore it is most important that during welding measures are taken that the inner dimensions of the casings are within the specifications set by the manufacturer. Due to the performance of the incompressible rubber parts, all forces applied on the rubber will be directed to the side walls of the casing. The ULEPSI tank support 200x200 type is approved for continuous loads of 320 kN and the 350x350 type of loads of 980 kN.

Note: mechanical strength of the casing has to be ensured to cope with the forces which might occur to the casing under pressure load and movement. A milled version is in this respect advisable.
The newest version of the casings for the ULEPSI tank support system is a milled version to exclude welding in the corners and in this way obtain more stability. Also these casings are generally made by the yard. Caution has to be taken that the milling process is of such a quality that the inner dimensions of the casings are within the specifications.

In the case of a milled casing holes are drilled in the corners to let the air out when inserting the rubber plates.

With a view to the possible angled position between the ULEPSI tank support and the beam of the tank it is of utmost importance that the levelling plate is positioned about 10 mm deep inside the casing. Although tests have shown that ULEPSI tank supports can cope with angle differences of up to almost 4°, it is advisable not to exceed a difference of 5 mm measured over the length of the casing.

CHEMICAL CARRIER “STELLA LYRA”: built in 1988 by Damen Shipyard, The Netherlands. More than 400 ULEPSI tank supports are installed in the hull of this vessel. The vessel has been in operation now for 20 years, without having a single ULEPSI tank support repaired or replaced. ULEPSI is a proven system of highest quality.

The steel casings to accommodate the inserts of the tank supports are welded on the construction down in the hull of the vessel. A sister ship of the Stella Lyra is also equipped with the ULEPSI tank supports. The Stella Polaris, built in 1998/1999 by De Schelde Yard, The Netherlands for the same owner, is equipped with 535 tank supports in milled casings.

Before the start of the building of the Stella Polaris, BEELE Engineering commissioned SHAPE Technology Consultancy to calculate the temperatures which might occur on the supports and the surrounding in the bottom of the vessel. We refer to report W98.513. Based on the outcome parameters were set for testing the ULEPSI 200x200 mm by TNO. We refer to report BU4.98/025112-1/BB.
CHEMICAL CARRIER “RATHBOYNE”: built by Barkmeyer Stroobos Shipyard, The Netherlands. 516 ULEPSI tank supports are installed in the hull of this vessel. Using the ULEPSI tank supports eliminates stresses in the hull caused by the temperature differences between cargo and seawater. Excluding the mechanical stresses results in a substantial reduction of maintenance costs. Asphalt tankers, equipped with the ULEPSI tank support system, have been built also in China and Turkey. The largest vessel today is the CHARLOTTE built in Turkey (11,163 m³) by Yardimci Shipyard in 2005. On this vessel ca. 1000 supports; the majority 200x200 series and some 350x350 series.

ULTRA MODERN DESIGN ON THE BASIS OF THE BULK MODULUS OF RUBBERS FOR TANK SUPPORTS CARRYING HEAVY LOADS UNDER HIGH TEMPERATURES
THE CASINGS OF THE TANK SUPPORTS WITH INSIDE DIMENSIONS 200x200 mm ARE POSITIONED WITH A CALCULATED INTERSPACING ON THE STEEL CONSTRUCTION IN THE BOTTOM OF THE HULL.
ABOUT 500 TANK SUPPORTS ARE INSTALLED IN THE BITHAV, AN ASPHALT CARRIER WITH TWO ASPHALT TANKS BUILT BY FRISIAN SHIPYARD WELGELEGEN, THE NETHERLANDS.
THE CASINGS HAVE A SPECIAL PROFILE AT THE OUTSIDE TO OBTAIN MAXIMUM STIFFNESS. IN THE CORNERS A SMALL HOLE IS PROVIDED TO LET THE AIR OUT DURING THE INSTALLATION OF THE ULEPSI RUBBER PLATES.
THE ULEPSI PLATES WERE PLACED IN THE CASINGS OF THE TANK SUPPORTS BEFORE THE INSIDE OF THE HULL WAS PAINTED. ON TOP A SHEET OF CARDBOARD WAS PLACED TO PREVENT THE PLATES FROM BEING PAINTED.
AN OVERVIEW OF THE ULEPSI PLATES (ULEPSI-E, -S AND -G) AS THEY ARE PLACED IN THE CASINGS OF THE TANK SUPPORTS. ULEPSI-E AT THE BOTTOM, -S IN THE MIDDLE AND -G AT THE TOP.
ULEPSI
FLEXIBLE SUPPORT SYSTEM FOR INDEPENDENT TANK CONSTRUCTIONS

ULEPSI-E (BLACK) AT THE BOTTOM, ULEPSI-S IN THE MIDDLE AND ULEPSI-G AT THE TOP
THE ASPHALT TANKS ARE MANUFACTURED AND INSULATED IN THE WORKSHOP OF THE YARD. THEY ARE LIFTED WITH A HEAVY CRANE INTO THE HULL OF THE BITHAV. ALL CARDBOARDS REMOVED.
FLEXIBLE SUPPORT SYSTEM FOR INDEPENDENT TANK CONSTRUCTIONS

BOTTOM OF THE ASPHALT TANK

BOTTOM OF THE HULL WITH THE ULEPSI TANK SUPPORTS
THE ASPHALT TANKS ARE PLACED ON TEMPORARY SUPPORTS TO ALLOW FINAL INSPECTION AND .....
TO MEASURE THE DISTANCES BETWEEN THE BEAM OF THE TANK AND THE TANK SUPPORTS TO DETERMINE THE THICKNESS OF THE LEVELLING PLATES AND A POSSIBLE NEED FOR MILLING THESE TO THE CORRECT ANGLE.
A CASING OF THE ULEPSI TANK SUPPORT WITH THE ULEPSI PLATES AND ON TOP THE LEVELLING STEEL PLATE. AFTER ALL LEVELLING PLATES WERE INSTALLED THE TEMPORARY SUPPORTS WERE REMOVED.
The ULEPSI tank support construction by Beele Engineering is designed for application on board carriers for the transport of products which, for reasons of viscosity, have to be maintained at a high temperature level (asphalt, coal tar, creosote, etc.). These products are transported in cargo tanks the walls of which are exposed to temperatures of 200 °C and more. Due to the large temperature difference between the tank wall and the sea-water, the tanks are subjected to high stresses, and a support construction has to be employed which reduces the temperature to an acceptable level. Besides reducing the temperature, the support construction also has to have sufficient compressive strength and the various elements have to possess optimized coefficients of friction. The ULEPSI tank support construction by Beele Engineering complies with all these conditions. The two tanks on board the Bhitav rest on 541 tank supports. The ULEPSI tank support is a sandwich construction of polymeric materials, consisting of one plate of black rubber polymer 18 mm thick, one plate of red-brown rubber polymer 15 mm thick, and one plate of glassfibre-reinforced rigid plastic 12 mm thick. Steel plates with thicknesses ranging from 15 mm to 35 mm serve as the tank legs. The BITHAV asphalt carrier has been built by Frisian Shipyard Welgelegen for Shipyard De Biesbosch. The vessel is equipped with two cargo tanks with a combined total capacity 5700 m³. The fully insulated tanks are partitioned into compartments. The maximum cargo temperature is 250 °C. A sister vessel, the BITFLOWER, has been built by Bijlsma Shipyards. The various components of the tank support construction by Beele Engineering are subjected to comprehensive testing. This includes inspection during the production of the glassfibre-reinforced plates, and checks on weight and dimensions for the specified tolerances, besides X-ray scanning. In addition, the rubber types used are quality-controlled, and their dimensions etc. are inspected both during and after production. **ISO 9001:2001 certificate nr. NL7001684 issued by Bureau Veritas.**
ARTIST IMPRESSION OF THE FIRST PHASE OF THE NEW FACTORY NEXT TO OUR R&D CENTRE

1) machines specially developed for compounding and processing of rubbers under controlled conditions to obtain optimum quality
2) machines specially developed for compounding and manufacturing of all types of sealants under controlled processing
3) moisture treatment installation and processing equipment for manufacturing of electrically conductive sealants and rubbers
4) a complete line of injection moulding presses ranging from 40 tons up to 400 tons for manufacturing sealing plugs and other rubber components
5) a complete line of compression moulding presses up to 300 tons for manufacturing larger type sealing plugs and ULEPSI rubber plates
6) processing installation for after-curing of rubber products to obtain the required compression set (long term behaviour)
7) extruder line including cooling system and cutting and slitting installation for manufacturing insert and filler sleeves for the RISWAT system
8) fully automatic extruder lines with a length of 20 meters, including cooling system and automatic cutting, slitting and sorting installation for manufacturing rubber insert and filler sleeves and rubber strips of the RISE system
9) extruder line for manufacturing luminescent profiles and hoses
10) injection moulding machine for manufacturing thermoplastic YFESTOS products and other plastic parts
11) completely equipped die-making shop for the in-house production of all tooling for rubber and plastics manufacturing
12) modern laser equipment for engraving the type codes in the dies for rubber manufacturing and for marking products with bar and 2D-matrix codes
13) mixing and airless spraying facilities for the NOFIRNO boards

Together with highly advanced systems and technologies we offer highest quality products.

BEELE ENGINEERING YOUR RELIABLE PARTNERS
THE OPTIMUM SOLUTION FOR:

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ASK FOR THE SEPARATE BROCHURES ON OUR PRODUCT RANGES:

* RISE® MULTI-CABLE TRANSIT SYSTEM
* RISE® SEALING SYSTEM FOR SINGLE AND MULTI-PIPE PENETRATIONS
* RIACNOF® MULTI-CABLE TRANSIT SYSTEM
* RISE®/NOFIRNO® MULTI-ALL-MIX CABLE AND PIPE TRANSITS
* RISE®-ULTRA SINGLE PLASTIC PIPE PENETRATIONS
* RISWAT® GAS AND WATERTIGHT CABLE AND PIPE DUCTS
* SLIPSIL® SEALING PLUGS FOR PIPE ENTRIES
* SLIPSIL®-SQ MULTI-CABLE TRANSITS
* DYNATITE® DYNAMIC HIGH PRESSURE SEALS
* BEESEAL® MULTI-PIPE AND CABLE PENETRATIONS
* ACTIFOAM® TEMPORARY SEALS AND CAVITY SEALS
* FIRSTO® FIRESTOPS FOR CABLE TRAY PENETRATIONS
* NOFIRNO® CAVITY SEALS, COATINGS AND SEALANTS
* ULEPSI® TANK SUPPORTS FOR BITUMEN TANKERS
CONDUIT SEALING DEVICES OF AN AMAZING SIMPLICITY WITH AN OUTSTANDING PERFORMANCE

BEELE Engineering and CSD International have been involved with fire, water and gas tight sealing for more than 30 years. We have developed and tested products proven to provide the utmost in sealing protection around the world. To receive our complete civil construction and/or marine products catalogues, please contact your distributor or local representative.

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