Komposites

low temperature application
Insulam EH Type 5 and Type 6
data sheet

A WORLD OF PRODUCTS FOR INDUSTRY

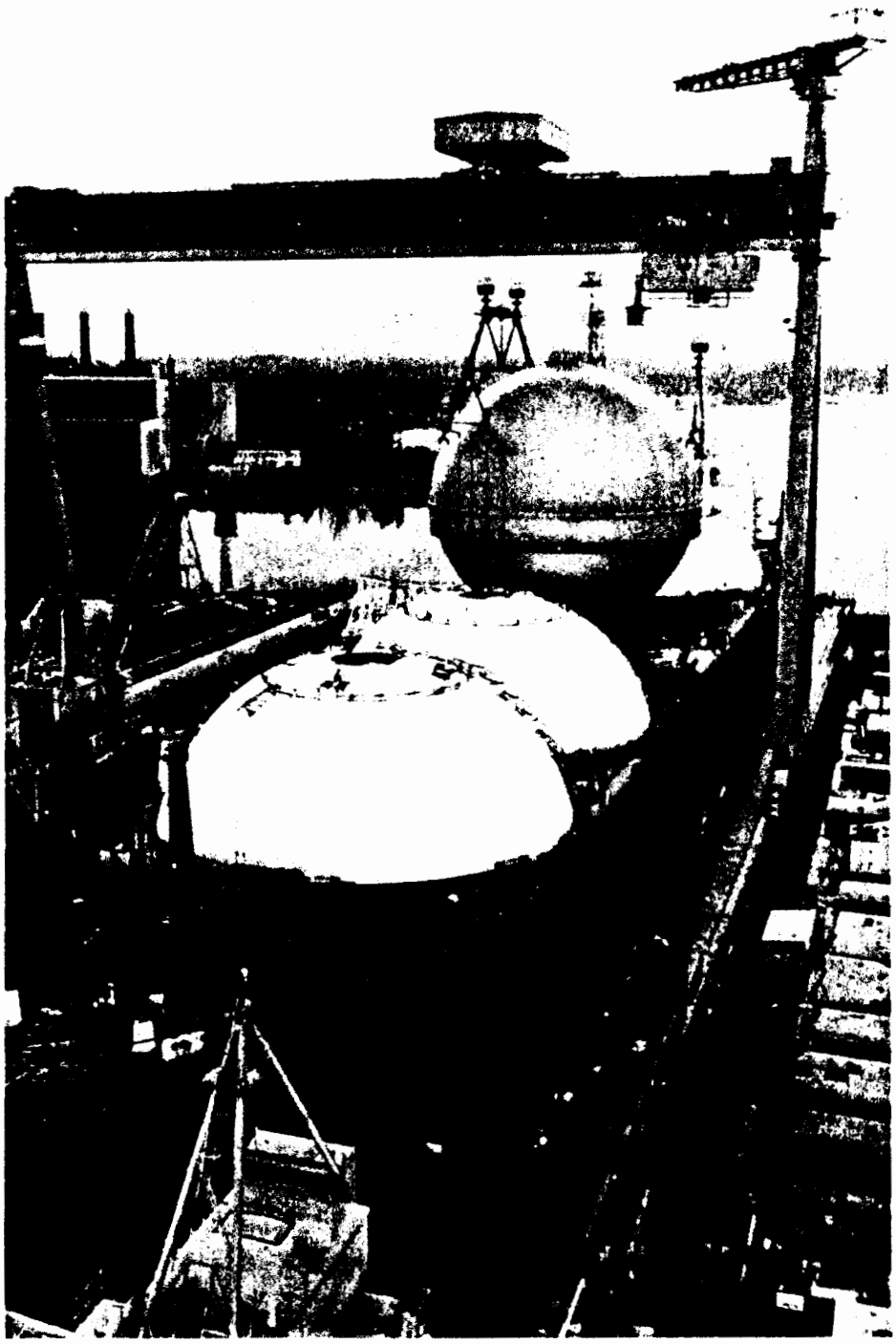
Insulam EH is a dependable material for applications requiring the combination of thermal insulating qualitites with good mechanical strength at cryogenic temperatures. The strength-to-weight ratio of Insulam EH exceeds structural steel at both ambient and cryogenic temperatures in compression, tension and flexure.

Insulam EH has been proven in service by liquid natural gas (LNG) transportation and storage vessels. Successful land and sea applications include tank sealing rings, pipe saddles, tank supports, keys and pitch-and-roll chocks. Insulam EH coil forms are also in operation in a series of superconductivity studies involving a liquid helium environment.

Two Types of Insulam EH are Available:

Insulam EH-5 with unidirectional grain, and Insulam EH-6 with 50% cross grain. Each type is a homogeneous material made from carefully selected thin beech veneers which are impregnated under vacuum with a special synthetic resin and then densified through the application of heat and pressure.

The following tabular data have been developed and assembled to help the design engineer compare Insulam EH-5 and EH-6 under conditions of stress for liquid gas temperatures versus normal room temperature values. In all cases the figures shown are an average of a sufficient number of determinations to give a dependable result. Also, maximum and minimum values did not vary enough to require weighting of the average.



An insulated sphere, utilizing Insulam EH studs, being lowered into position.

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Physical Properties

Thermal Conductivity (Btu/hr/ft²/°F/In.)

Sample	Direction of Heat Flow	Low Temp.	Room Temp.
EH -5	Parallel to laminations, Perpendicular to grain	1.622	2.15
	Perpendicular to laminations, Perpendicular to grain	1.556	2.05
	Parallel to laminations, Parallel to grain	2.620	3.69
EH-6	Parallel to laminations, Parallel to grain	1.960	2.76
	Perpendicular to laminations, Perpendicular to grain	1.514	1.98

Tests were conducted using a guarded, parallel plate cell in which the "hot" surface was maintained at 14°C, and the "cold" surface at -183°C. These data are listed as low temperature.

Thermal Expansion or Contraction (In./In./°C)

Sample	Direction of Measurement	Low Temp.	Room Temp.
EH -5	Parallel to laminations, Parallel to grain	6.4×10^{-6}	8.0×10^{-6}
	Perpendicular to laminations, Perpendicular to grain	23.7×10^{-6}	113.0×10^{-6}
EH-6	Parallel to laminations, Parallel to grain	18.0×10^{-6}	15.0×10^{-6}
	Perpendicular to laminations, Perpendicular to grain	33.0×10^{-6}	113.0×10^{-6}

Tests were conducted using carefully polished cubes with a nominal dimension of 1". Measurements were made at 16°C and -194°C, giving the average rate of dimensional change over a range of 210°C. These measurements are noted as low temperature.

Mechanical Properties

Tensile Strength (psi)

Sample	Direction of Measurement	-192°C	20°C
EH -5	Lengthwise	25,213	32,500
EH-6	Lengthwise	11,386	15,000

Compressive Strength (psi)

Sample	Direction of Measurement	-192°C	20°C
EH -5	Parallel to face and grain	46,592	21,117
	Perpendicular to face	18,368	21,392
EH-6	Parallel to face	38,192	26,320
	Perpendicular to face	28,952	38,584

Shear Strength (psi)

Sample	Direction of Measurement	-194°C	20°C
EH-5	Parallel to grain	2,790	3,460

Impact Strength (ft-lb/in. of notch)

Sample	Direction of Measurement	-194°	20°C
EH -5	Perpendicular to face	4.66	5.71
	Parallel to face	4.45	5.15
EH-6	Perpendicular to face	2.97	3.51
	Parallel to face	2.33	2.63

Conclusions

1. It was found that the ultimate tensile strength of Insulam EH 57 (straight grain) at -192°C is 22% lower than at room temperature, and that the ultimate shear strength of the same material at -194°C is 19% lower than at room temperature. Since torsion is a combination of tension and shear, it is reasonable to assume that the ultimate torsional strength at -192°C will be 3,600 psi, or 80% of the room temperature value.

2. The effect of compressive loading at reduced temperatures varies with the direction of application, which is due to the fibrous nature of the material and to a hardening or "freezing" of the resin.

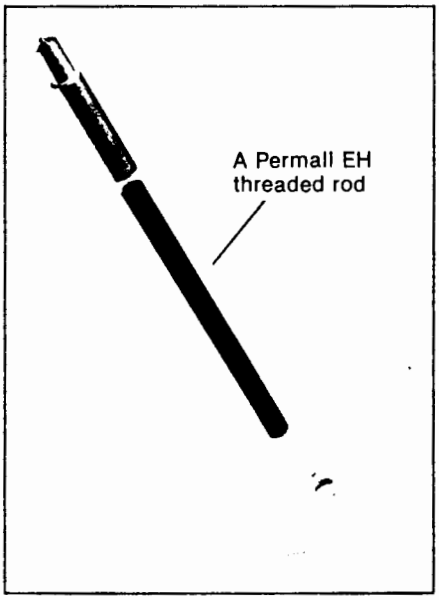
3. In practical application, Insulam EH at low temperature is usually called upon to serve as a load bearing thermal insulator. With established mechanical properties at reduced temperatures, it is possible to design accurately. Also, since impact strength is of the same order at -194°C as at room temperature, it follows that safety factors at low temperature do not need to be greater than at room temperature.

4. The thermal resistance of Insulam EH is of the same order as other insulating materials, but due to the superior mechanical strength of Insulam EH 1, it can frequently be used in smaller section, thereby reducing heat flow.

5. In all design work, note should be made of the thermal contraction because machining would be carried out at room temperature. Methods of fastening and fit must make allowance for contraction and the fact that such contraction is not uniform in all directions.

Application Assistance

You can rely on the maximum technical and economic advantages when you work with CK engineers. Take advantage of this experience prior to final design in order to develop the best and least expensive assembly.



Insulating stud assembly for LNG sphere using Permall EH threaded rod.

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