DILLINGER HÜTTE

DILLINGER SPECIALITIES FOR OFFSHORE APPLICATIONS

HIGH-STRENGTH PLATE FOR JACK-UPS

OFFSHORE SPECIALITIES FROM DILLINGEN

Reliable partner for the offshore industry

The fossil energy sources, oil and gas, will continue even in coming decades to enjoy great importance in global energy supplies. Dillinger Hütte has long been an established and reliable supplier of technologically sophisticated heavy plate and components fabricated from it for offshore oil and gas production.

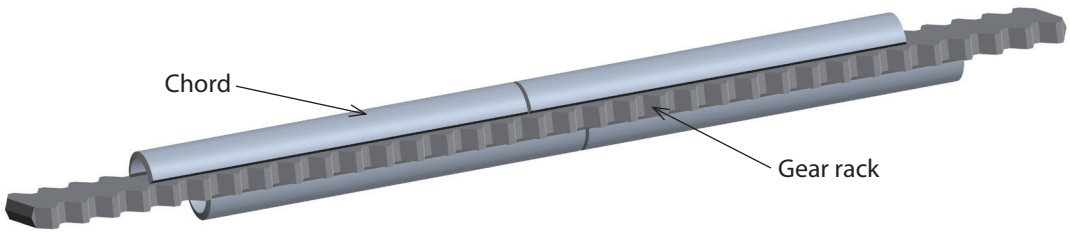
So-called jack-up rigs (or simply "jack-ups") play a vital role in the exploration and development of oil and gas deposits, and in the exploitation of smaller reserves. The design of mobile platforms makes it possible to set them up temporarily at water depths of above 150 m. The vertically extendable rig legs, which may be more than 200 m in length, depending on particular design, anchor the hull to the seafloor, raising it above the water surface out of the range of wave attack. Such rigs are designed to withstand wave heights of over 20 m. The deck of the jack-up accommodates the crew, plus the actual drilling rig and other important equipment.

The „Independencia 1" jack-up

Wind farm installation vessels transport the foundation structures, towers and turbines of offshore wind-power systems. As in the case of jack-up oil/gas rigs, the hull is raised at the work site, assuring safe installation of the foundations from the vessel's deck.

Jack-up legs with a heart of heavy plate

The jack-up rig or wind farm installation vessel, depending on its specific type, will have three to six legs, each consisting of a rigid lattice structure. The load-bearing components of this structure joined via bracings take the form of a unit composed of a gear rack and a welded-on chord:



The basis for the gear rack and the chord is provided by high-strength heavy plate. Loads acting on the plates in the through thickness direction, resulting, for example, from welded connections, generally require special deformation properties even perpendicular to the plate surface (so-called "Z-properties"). Transmission of the enormous loads via the tooth flanks necessitates high material homogeneity. The latter is also an important precondition for good toughness values throughout the plate cross-section.

Special properties and dimensions for Dillinger plate

Depending on the requirements specified, Dillinger Hütte plates for fabrication to gear racks or chords are characterised by the following property profiles (further details can be found in the DI-RACK material data sheet, available at http://www.dillinger.de):

	Type B	Type M	Type S
Minimum yield strength R_{eH} [MPa]	690	723	723
Tensile strength R_m [MPa]	770 - 940	793 - 960	830 - 990
Minimum elongation A_5 [%]	15	14	14

Z-properties assuring minimum values of 35 % for percentage reduction of area can be adjusted for plates loaded in the through thickness direction. The plates, homogenised right down into their centre, achieve excellent Charpy V-notch toughnesses throughout the plate cross-section at temperatures down to –60 °C depending on the customer requirements.

Dillinger Hütte has a large range of dimension formats available for plates possessing these properties. Demand for plates for production of chords is generally restricted to thicknesses of up to 120 mm (4¾"), whereas plates in thicknesses up to 210 mm (8¼") are rolled for gear racks. Maximum plate weights of around 40 t permit plate lengths of above 12 m.

High-strength plates in large plate thicknesses and with ultra-tight dimensional and geometric tolerances

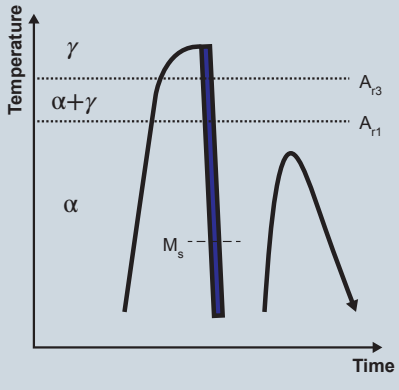
Production of large-thickness high-strength plate

These properties and formats can be achieved only using sophisticated metallurgical concepts and the appropriate processing equipment throughout the production path from the pig iron to the finished plate. Here, Dillinger Hütte possesses decisive advantages, as an integrated iron-and-steel mill. Vacuum treatment in the steelmaking plant assures high steel cleanliness. Slabs and ingots of high individual item weights and great thickness are then vital, to assure adequate potentials for deformation of the material in the downstream forming process. High reductions in thickness per forming operation assure adequate deformation of the plate centre and the elimination of solidification-induced porosity. One precondition for this are rolling stands such as those installed at Dillinger Hütte, which apply the necessary high rolling forces to the material during the concluding shaping process. The parent plates are submitted to quenching and tempering after rolling.

Quenching + tempering process (schematic):

- Austenitising: heat soaking up to austenitising temperature (approx. 900° C)
- Quenching: water-cooling to below the martensite starting temperature M_S at an adequate rate of cooling
- Tempering at temperatures below A_{r1}

Result:
A microstructure with extremely good strength and toughness properties



ABS and DNV approved

Dillinger Hütte possesses ABS and DNV approvals for steels of yield-strength class 690 MPa. Steel grades AQ – FQ70 / A690 – F690 can be supplied as ABS or DNV grades with defined properties in the through thickness direction in plate thicknesses of up to 210 mm.

More than just plate

The production and processing of such steel grades and formats demands special know-how and corresponding equipment. Dillinger Hütte's Heavy Fabrication shop cuts high-strength plates to gear racks of up to 12 m in length. Like the original plate, these products meet the very tightest dimensional and geometric tolerances.

Flame cut gear racks in Dillinger Hütte's Heavy Fabrication shop

Dillinger Hütte's Heavy Fabrication department also produces hot-formed chords, another product destined for use in the legs of jack-up rigs and wind farm installation vessels. The dimension range permits lengths of up to 5 m and, depending on bending radius, wall thicknesses of over 120 mm.

Hot-formed chords in Dillinger Hütte's Heavy Fabrication shop

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