Experience where it counts.
Innovation where it matters.

INTERMEDIATE TENDON CONNECTOR

The GMC Intermediate Tendon Connector (ITC) is a field proven, concentric thread, pin and box connector design that combines high strength and excellent fatigue resistant properties with fast and reliable field make-up.

The weldable connector material permits high strength and fatigue resistant tendon joints to be prefabricated in a shore based workshop and then assembled safely and quickly offshore into the full tendon length.

Assembling tendons offshore with proven fatigue resistant connectors and 100% shop controlled welding, guarantees the maximum level of tendon reliability and reduces offshore construction time.

Based on modern analysis techniques, GMC’s ITC design is highly optimised to reduce stress concentrations and improve performance over older designs in the marketplace.

GMC’s Intermediate Tendon Connector is guaranteed to beat the competition on performance, price, and delivery lead times.
**ITC Box and Pin Connection**

Tendon Leg Platform (TLP) tendons are a demanding application for mechanical connections, requiring high strength, fatigue resistance and sealing.

The majority of successful TLP projects to date have relied on a box and pin, hydraulically made up connector for offshore assembly of tendon joints. GMC’s ITC advances this proven connector design with a number of design enhancements.

The GMC Intermediate Tendon Connector

- consists of a proven concentric ring pin and box connector.
- is made up axially using a combination of axial force and hydraulic annulus pressure.

**Mechanical Connection Process**

The GMC ITC employs a simple axial makeup process that can be completed in less than five (5) minutes once the box is stabbed onto the pin. The connection is made up by simultaneously applying an axial clamping force and a connector annulus pressure (causing the pin to contract and the box to expand.) Re-pressurisation of annulus after the make-up provides reliable proof test of connector sealing integrity.

**ITC Material**

ITC’s are typically made from A707 3W. However, ITC’s can also be customized to conform to client requirements: low alloy and age hardenable steels, as well as, titanium alloys, etc.

ITC material is not limited to steel.

**ITC Specification**

GMC engineers can adjust the connector design to all tendon operational extremes and survival conditions for bending moment and Tension Load specifications.

Connectors are commonly adjusted for all Tendon sizes ranging from 12” to 48” and larger diameters.
### Qualification Tests and Certification for Tendons

The following table lists a typical qualification test program for tendon connectors.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Components</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Make-break Test</td>
<td>1 Coupling Set</td>
<td>(5 cycles) on one strain gauged connector set</td>
</tr>
</tbody>
</table>
| 2    | Load Test / Hydrostatic Test | 1 Coupling Set | a. Tension Load test at design proof load  
b. Hydrostatic Load Test (External Pressure with Load)  
c. Includes internal shipments, welding of free issued pipe for testing |
| 3    | Full Scale Fatigue Test | 6 Coupling Sets. Free Issued Pipe. | a. Low Stress Range (2 connector sets)  
b. Medium Stress Range (2 connector sets)  
c. High Stress Range (2 connector sets) |
| 4    | Material qualification & testing to API RP 2Z | 1 Set Weld Qualification Rings | Includes testing as per Foundry Audit conclusions (welding according to agreed energy, CTOD test in HAZ) |

### Customised Features

For each new TLP project, GMC engineers will work closely with the operator to design a project specific qualification program that leverages the extensive testing that has already been completed and provides the appropriate level of design validation and qualification.

*For example, watertight bulkheads can be designed within the ITC for tendon compartmentalisation.*

### Certifications

Intermediate Tendon Connectors can be certified in accordance with any of the major 3rd party classification rules, and typically include:

- DNV Offshore Standard (DNV-OS-C105) Structural Design of TLPs (LRFD Method),
- ABS Rules for Building and Classing Floating Production Installations, or
- API RP 2T Recommended Practice for Planning, Designing, and Construction of Tension Leg Platforms.

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**ISO 21329 Qualified**

The international standard specifying requirements and providing guidance for the testing of mechanical connectors for use in pipeline transportation systems for the petroleum and natural gas industries.

*It defines a series of stringent tests to provide objective evidence that mechanical connectors conform to a defined performance envelope.*

GMC performed the ISO test qualification processes under 3rd party survey by DNV.

The GMC Mechanical Connector successfully completed all testing in January 2010 and is one of the first connectors to be qualified to this standard.
**GMC Intermediate Tendon Connectors**

**ITC Delivery Timeline**

GMC will work with the client and sub-contractors to meet timely delivery of the ITC based on an optimal delivery management system.

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**Moho Nord TLP Project**

GMC is currently supplying over 100 sets of its concentric thread, pin and box type connectors under contract for the Moho Nord TLP project.

The 16,500 ton TLP hull and topsides will be vertically moored in over 780 meters water depth by the tendon tethering system. GMC’s high strength fatigue resistant mechanical connector will provide the intermediary connectors on the tendons. The 24 inch OD connectors have rated operating capacity of 790 metric tons and a survival rating of 2000 metric tons.

The scope of supply includes the connectors, the make and break tool, spider table hang-off tool, and a tendon handling tool. GMC technicians will also provide tendon installation support. The connectors will be constructed using A707 material complete with end cap protectors for transportation to the fabrication facility.
**Connector Delivery Management**

GMC will supply the polyurethane protective cap protectors in order to safely protect the connector threads ends for delivery to final fabrication. Care will be taken to ensure that the connector pin and box remain unharmed during delivery. In addition, several spare connector sets will typically be supplied as a precaution against unforeseen events.

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**TLP Installation Support**

GMC will supply all of the equipment and expertise for installation of the tendon connectors offshore. A highly trained offshore running service team will assist with the ITC connection make-up.

- Supply of Tendon Handling Tool
- Supply of Spider Tool
- Supply of Make-Break Tool
- Supply of Hydraulic Power Unit (HPU)
GMC's Mechanical Connector

GMC Connectors of 6”-16” diameters are jointed to the pipe using friction joining. This results in pipe joints that are 100% parent metal and exhibit fatigue and strength properties comparable to the parent pipe.

GMC Connectors of 16” - 48” diameters are welded in a controlled environment; onshore, off critical path, and monitored in a quality-controlled environment.

GMC's Intelligently Connected Pipe (ICP)

The GMC Mechanical Connector is the core technology behind our pipe connection technology, Intelligently Connected Pipe, or ICP.

ICP delivers a more robust pipeline, whilst simplifying and reducing installation costs. ICP allows the time consuming joining operation to be performed onshore and off the critical path. During offshore operations, only the fast coupling of the male and female connector is performed by a single connector station.

As a result, the offshore installation contractor can effectively reduce the stand-by time and the actual operation time of the installation vessel and personnel with better planning and with more efficient technology.

GMC Mechanical Connector Applications

- Hybrid Free-Standing Risers
- Standard Steel Catenary Risers (SCRs)
- Lazy Wave SCRs
- Offset SCRs (OSCRs)
- Top Tension Risers
- Drilling & Production Risers
- Marine Drilling Risers
- Work Over Risers
- Pipe-in-Pipe
- End Terminations
- Inline Connections
- Abandon Heads
- Wet/Dry Recovery Heads
- Flow Line Jumpers
- Subsea Tree
- Stab/Hinge Over
- Large Diameter Fatigue Resistant Conductors
- Tendons for Tension Leg Platforms (TLPs)

About GMC

GMC is an industry leader in innovative engineering, project management, and installation solutions and products, from the seabed to the surface, for offshore oil and gas SURF, drilling, and production projects. Established in 1990, GMC has offices in the UK and USA.