

**Exploration and production of oil and gas is taking place in ever more remote regions. Some of the world's most promising oil and gas deposits lie deep in the tropics, for example Papua New Guinea, Malaysia and even the Amazon rain forests. With oil at historically high prices, the incentive to develop these oil resources has never been greater. This poses new challenges for manufacturers to design equipment that can operate reliably in high temperature and humidity environments.**

Tropicalisation of equipment can be traced back to the early 1940's when radio-communication equipment designed and produced to standards of performance and endurance which had proved satisfactory in both temperate and dry tropical climates found its way into damp tropical areas. In these conditions it was found that the equipment deteriorated quickly with some materials decaying rapidly and components failing more than would be expected. The industry had to make changes to the design with materials and coatings that could withstand the environment and components that were not stressed by the extreme heat and humidity.

Today in the oil and gas industry, API 610 is widely used to ensure that equipment is capable of performing reliably in the conditions it is used. However, when it comes to equipment that has to work in hostile tropical climates, the API 610 datasheet has just a tick box indicating tropicalisation is required. Within the API 610 technical specification there isn't any clear definition for this nor any further guidance for material selection or design considerations to assist customers or manufacturers.

Amarinth has been engaged by many global oil and gas companies to provide advice and engineer pumps that can withstand hostile tropical environments and has found that pumps used in tropical climates require careful selection of materials and coatings and designs that prevent damage from condensation.

## Tropical conditions

The definition of tropical temperatures varies widely but, as a guide, temperature extremes of -5C (at night) to over 55C (in direct sun light) could be considered as tropical environments. Although temperature alone doesn't dictate when to start considering tropicalisation, humidity is more defined with 70 to 100% being the typical levels of relative humidity when issues may start to occur if consideration is not given to these humidity levels during design and manufacture.

## Materials

Selection of materials is related to the prevention of corrosion, oxidation and the potential build-up of growth on the pump. 316 Stainless Steel is usually the minimum choice of material however the pump fluid will determine ultimate material selection. Duplex stainless steel or any number of exotic alloys maybe required for the duty. The maintenance and appropriate material type is similar to any environment in as much as controlling the corrosion of maintenance parts/fixtures and bolts will determine the appropriate material selection. Lesser material grades are an option and if used would require appropriate covering (paint specified to prevent material oxidation and growth build-up).

The purchaser is responsible for determining material requirement and the supplier for meeting standard and delivery. Technically experienced suppliers will be capable of providing possible alternatives for consideration that meet the duty, environmental requirements and standards.

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## Base-plates

The frame arrangement and sizes will follow the API sizing and design unless specified by the purchaser. Surface finish should be to Sa 2.5 (equivalent to ISO 8501) and it is recommended that an acrylic top coat or equivalent is used. The industry usually follows the Shell DEP specifications. It is also important to ensure that there are no water traps in the design that would harbour the growth of moulds and bugs.

## Seals and seal support systems

Data from the main manufacturers of seal systems has found no reference to any major differences or special requirements for tropical environments other than the material selection is generally duplex stainless steel and the top coating for the reservoir should prevent growth on the surface.

In environments where the maximum temperature exceeds 55C, Air Cooled Heat Exchangers may be required around the equipment or increased in size as appropriate and sun shades should be included for all instrumentation.

## Material finish

In order to prevent growth on the surface a smooth finish is desirable that is water and microbe resistant. The surface finish of any castings should be to Sa 2.5 (equivalent to ISO 8501) - blast cleaning to remove all millscale, rust, paint and foreign matter to achieve near white metal. If painting, a rust inhibiting primer should be applied. Top coatings vary by manufacturer but would normally be silicon based, polyurethane or epoxy usually with a thickness of between 285 and 350 microns.

## Motors and drives

In a tropical environment heat generated by the motor will create condensation regardless of usage (intermittent or long periods). Condensation within the motor will eventually damage the windings. Thicker silicon based varnishes should therefore be applied to protect the windings from oxidisation. There should also be additional condensate drainage holes within the motor housing. The use of anti-condensate thermostatically controlled heaters within the motor housing are recommended in very high humidity environments.

To prevent the possibility of dust and water ingress IP65 (i.e. dust tight and protected against water jets) is the standard often requested for motors unless the pump is being used offshore or around other specific water hazards in which case the protection against liquids may be higher.

Stainless steel is usually the minimum choice of material for all main motor components. Fixings (bolts, nuts etc.) are preferably stainless steel but if carbon steel fixings are used then a zinc based anti-corrosion compound must be applied.

## Oil sight glass

Consideration of the use of an oil sight glass in tropical regions is recommended. This can be fixed to the lowest point of the bearing bracket on a horizontal pump and is designed to collect any condensate from the bearing bracket.

The glass is normally constructed of an acrylic bodied vessel (glass is not allowed in an ATEX zone) with a brass maintenance valve sited at the bottom of the body for maintenance drainage. Condensate can often build-up within the bearing bracket housing as a result of temperature fluctuation and humidity and the oil sight glass is designed to allow condensate to sink to the bottom of the oil-filled glass thereby allowing for maintenance drainage. A typical acrylic bodied vessel is resistant to temperatures up to 110C.

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## Instrumentation

Monitoring instrumentation should be placed under sun shades for dial read minimum material specification should be 316 Stainless Steel.

Choose an item.

## Shipment, storage and installation

There are various storage and preservation procedures recommended to ensure the integrity of the equipment between shipment, storage and installation/start-up. For example storage of rotating equipment should be between 15C and 26C and less than 75% relative humidity to avoid microbe build-up and prevent corrosion. Humidity levels can be controlled during shipment and storage using vacuum packed bags and desiccants.

Seals may also require turning every three months. If this is the case and the pump is not to be commissioned for some time it is better to store the seals separately.

Over and above accepted procedures, for pumps destined for tropical climates, the pump manufacturer must work closely with the contractor and/or end user to ensure storage and installation procedures are sufficiently detailed to prevent damage to the pumps before operation.

## In Conclusion

Although at first glance there are not major differences between a standard pump and one to be used in a tropical environment, if the small differences in material selection, surface finish, fixings and motor specifications are not carefully considered this can lead to significant operating problems and reduced pump life.

Given that there is no “standard” for operating pumps in a tropical environment it is therefore worth checking carefully the details of what the manufacturer is offering when ticking the box for tropicalisation on the API 610 datasheet.

This Technical Bulletin is Amarith's interpretation of 'tropicalising' industrial centrifugal pumps and has been compiled from data and information received from various parties we have worked with in designing and manufacturing pumps for tropical regions.

### ▼ Revision history

Rev	Issue date	Reason for issue	Created by	Checked & approved by
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