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RECONDITIONING AND RECONSTRUCTION OF:
HEAT EXCHANGERS, COOLING COILS,
AFTER AND INTERCOOLERS, HOIST COOLERS.
MANUFACTURERS OF:
HEAT EXCHANGERS, COOLING COILS,
DUST FILTERS, SOUND ATTENUATORS.

Reg. No. 81/01911/07

1981 to Present

1.0 Manufacturing and Refurbishment of Cooling Coils.

Manos Engineering was established in 1981 and was initially involved primarily in the repairs/refurbishment of cooling coils for the gold mining industry.

This remains our prime focus and takes place at two workshops in Welkom, both of which are situated in 10th Street in the Industrial Area of Welkom.

One is our main workshop and office complex, and the second one is used for the removal of radioactive particles which may be present in the coils. These premises operate under our own Certificate of Registration (COR-137) issued by the National Nuclear Regulator (NNR). Specific transport procedures are also adhered to when collecting cooling coils and cooling cars from the mines.



Cooling Car before refurbishment



Cooling Car after refurbishment

The experience gained during the repair/refurbishment of various makes of cooling coils (e.g. Heat Exchanger Africa, National Heat Transfer and Silverton) was used to design new cooling coils without the inherent faults of these cooling coils.

Some of the faults and poor design features of the older coils are as follows:

- The use of applied finned tubing. Applied fin tubes have thin gauge fin material which is wound onto the tube making the fins are very soft and easily damaged. In some cases the fins lose contact with the base tube and this affects the heat transfer capability of the tube.
- The use of small internal diameter tubes which tend to block from the dirty water found in the mining industry.
- Using U-bends to create the water pass requirements for the coil. In any u-bend arrangement the tubes of each row are connected in series with one another, and should one tube be blocked all the tubes which are in series are removed from the circuit.
- Using dissimilar materials (e.g. copper and aluminium) in contact with each other. During the operation of the coil there is always a large amount of condensate and this condensate causes a galvanic action to occur between the copper and aluminium, resulting in intense corrosion taking place and subsequent replacement of the affected parts.
- Coil parts manufactured from mild steel which have to be replaced during normal refurbishment procedures.
- Manufacturers supplied coils that had shelf-rated duties and did not take into account the *actual underground environmental conditions*.



Corrugated finned tube (Applied fin)



Plate fin type coil with copper tubes and aluminium fins.

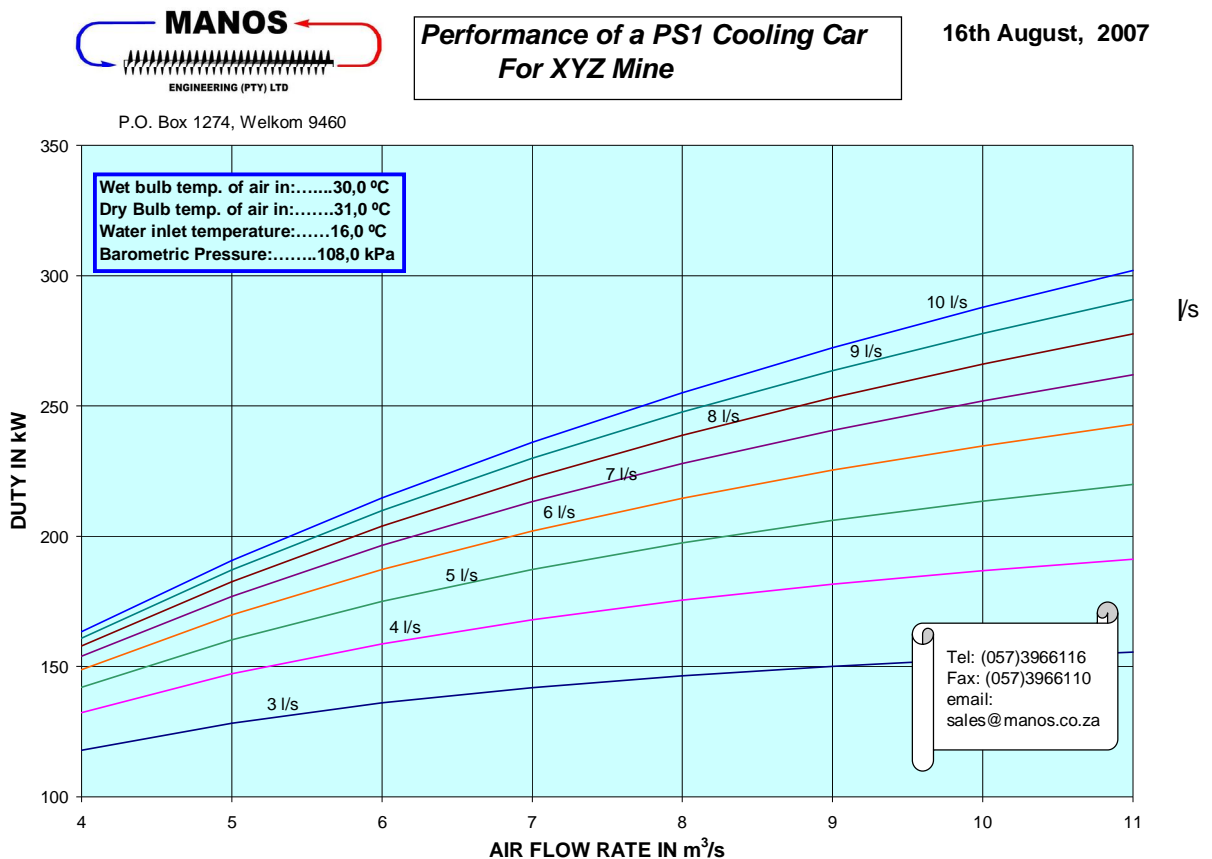
Our strategy was to provide the mines with coils which were designed for specific environmental parameters and duty requirements.

The prediction of Cooling Coil performance is a tedious task, and over the last 30 years we developed a computer program for the prediction of cooling duties for various air and water temperatures and flow rates for all of our coils.

This program has been continuously updated and has been validated by physical tests conducted at the C.S.I.R.

This program also provides graphical representation of how the cooling coil will perform at any given environmental parameters at varying water and air flow rates.

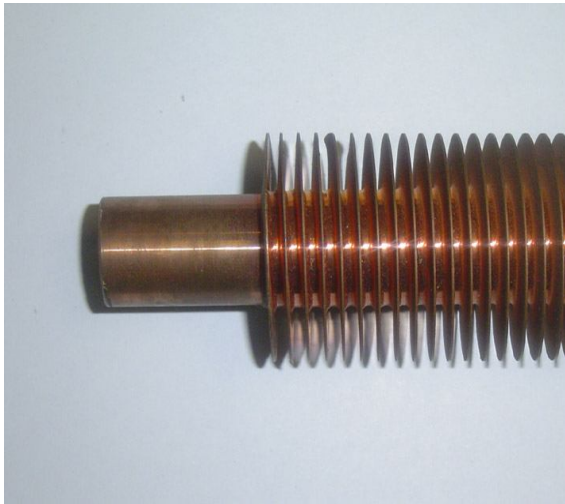
This is shown in the example below:



We are therefore able to design cooling coils to suit the client requirements, i.e. required duties for applicable size constraints etc.

2.0 Manos Engineering Standard type of Cooling Coils.

Our standard range of cooling coils, make use of extruded copper **HIFIN** tubing.



Extruded copper **HIFIN** tube.

Our standard range of coils are designed to exclude all the poor design features as mentioned above.

To this end we only use HIFIN extruded fin copper tubing in these coils.

Plenum type headers are cast from 316 stainless steel are used to connect the bank of tubes from one pass to the other. Investment cast 316 stainless steel nozzles are welded to these headers and contain the O-ring in a groove to seal the individual tubes.

Previously these headers were fabricated from 3CR12. Due to the early failure rate of the fabricated header, we designed and started using the cast 316 stainless steel headers as a standard. To elaborate on this feature, fabricated headers were replaced by 316 cast stainless steel headers for the following reasons:

1. After welding the tank to the tube plate, the external welds could be treated but the internal surfaces could not be treated and corrosion of the heat-affected zones took place.
2. The welding of the tank to the tube plate caused a crevice internally and crevice corrosion occurred.



Cross section through a cast 316 s/s header and a fabricated header.



New 300 kW Cooling Coil Car with 316 s/s headers and HIFIN tubes.

3.0 Other designs manufactured by Manos Engineering.

3.1 Radian Coils. (Plate fin type of coil)

We also manufacture high performance coils i.e. Plate Fin Coils. Our **Radian** coils, which we have recently supplied to AngloGold have also been tested by the C.S.I.R.. Once again, these tests showing that our performance predictions are valid.



420 kW Cooling Cars with top-hinged inspection cover.

Our **Radian** (Plate Fin coils) can be coated with a special coating by name of Blygold. The coating has been in use in Europe for the past 25 years and was specifically formulated for plate fin heat exchangers. The coating protects the aluminium fins from aggressive atmospheres, as well as inhibiting the galvanic corrosion, which occurs between the aluminium fin and the copper tubing.

3.2 Mongoose type Coils.

Recently we have designed a cooling coil which when assembled creates the same outside surface area as a plate fin design. This coil has the advantage that it can be disassembled into component form for regular refurbishment.

The fin and tube materials are both copper and the tube is coated with lead/tin as in our standard type of coil.



Mongoose type finned tubes

Mongoose type cooling coil being assembled.

We have supplied this coil to mines that regard the Plate fin type of coil as a disposable unit as it cannot be disassembled for repairs.

A plate fin coil is constructed by expanding the copper tubes into contact with the aluminium fins which means that once assembled it cannot be disassembled.

The **Mongoose** type of coil is assembled with individual tubes. The rectangular fin when assembled into banks create the same effect as a plate fin coil with the added advantage of being able to be dismantled into components for cleaning and refurbishment requirements.

The **Mongoose** type coil can be assembled using our stainless steel cast headers. Cost can be further reduced by replacing the castings with copper U-bends.

3.3 High Pressure (Hydro-Power mining) Coils.

For working pressures exceeding 10MPa (100 Bar) we are able to offer our standard range of coils using **HIFIN** copper tubes. These tubes will withstand a safe working pressure of 30 MPa and a test pressure of 45 MPa.

We have previously manufactured a 100 kW test coil in conjunction with the C.S.I.R.. and the Chamber of Mines, and this coil was successfully tested on Kloof Gold Mine.

Plate fin coils cannot be used in this application, as the expanding of the thick walled copper tube to the fin would be extremely difficult.

Our **Mongoose** type coil can also be used at the pressures required for Hydro-powered mining.

The photograph below illustrates the difference in wall thickness between the standard type of tube and that of a high pressure **HIFIN** tube:



High pressure and standard tubes

3.4 In-stope Cooling Coils

We have also designed smaller coils, which can be placed inside stopes or used in underground workshops etc. The standard type is manufactured using Bi-Metal **HIFIN** tubes and Plenum type Headers.

A lighter version of this type of coil is also available by using the plate fin method of construction.



Standard type 70 kW In-Stope Coil

4.0 Bulk Air Coolers

Several Mines opt to install Bulk Air Coolers underground using cooling coils in a closed circuit system.

We have designed and supplied several of these, including the manufacture and supply of all the steelwork, manifolds, valves and fans. In some cases we have also installed the B.A.C.



An Underground Bulk Air Cooler with a capacity of 1 750 kW

5.0 General.

Having manufactured our standard range of cooling coils and cars since 1982, we are proud that these coils and cars are still being reconditioned and refurbished some 30 years AFTER being supplied to various gold mines.

To date we have supplied in excess of 585 MW of cooling coils to the mining industry.



525kW Zeus Top-Discharge Cooling Cars



100kW Trojan Cooling Coil Cars