力诺瑞特 LINUO PARADIGMA SOLAR ENERGY

新常态 大未来

Medium Temperature Vacuum Tube Collector for Solar Cooling

LINUO-PARADIGMA

山东力诺瑞特新能源有限公司

Foreword

Collectors for solar cooling and heating include:

■flat plate collectors

■ vacuum tube collectors

■ heat pipe collectors……

higher operation temperature will help to improve COP for absorption chiller.

应用于太阳能制冷和采暖的太阳能集热器有平板集热器，真空管集热器，热管集热器。更高的工作温度可使制冷机组的COP得到提高.

However, higher operation temperature, such as more than 100℃，most solar collectors will have low efficiency, at the same time, thermal performance will decline distinctly after long time work.

但工作温度的提高，如大于100℃，一般的集热器效率较低，长期高温工作性能下降明显。

In order to increase the practicability, system components must be high operation temperature, with high efficiency, and long operating life.

要提高太阳能制冷的经济性，需要工作温度高，效率高，寿命长的系统部件。

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Foreword

Innovative system components require ：high efficiency, stable performance, reasonable price

创新性的系统部件需要：

效率高，性能稳定，价格合理

High efficiency: smaller area but same energy output ， suitable for single family house

效率高：相同的能量,面积更小，适合中小型化

Stable performance: long term high temperature operation, low attenuation.

性能稳定：长期高温工作，衰减少

Reasonable price: high price /performance ratio

价格合理：性价比高

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Our Works

Starting from the solar collector efficiency equation , we researched a collector for solar cooling system, since 2008.

我们从太阳能集热器的效率方程入手，从2008年开始，在热水集热器的范围里，研究适合太阳能空调的集热器

$$\eta = \eta_0 - a_1 T_m^* - a_2 G T_m^{*2}$$

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Our Works

The ways of improve performance:

1. increase η_0

- **Increase transmittance τ 提高透射比**
- **Increase absorpttance α 提高吸收比**
- **decrease emittance ε 降低发射比**
- **larger distance of tubes 采用宽管间距**

2. decrease a_1, a_2

- **Reduce tubes 减少真空管**
- **Reduce heat transfer resistance 减少传热热阻**
- **Connecting insolation 连接处保温**

3. copper pipe: anti-oxygenation 铜管氧化，集管保温层耐温

4. vacuum jacket: double-effect getter 真空：排气,非蒸散与蒸散并用

5. reflector: non –tracking 反射器：镜反射，固定反射器，非跟踪

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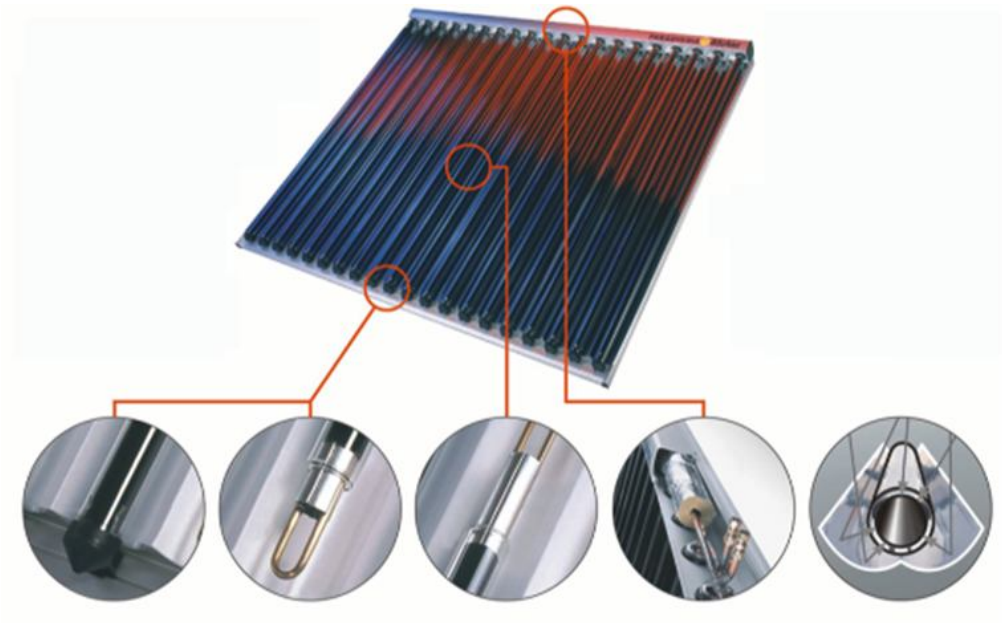
Our product

From the above, Shandong Linuo Paradigma Co., Ltd refined research and development, succeed in launching the medium temperature vacuum tube collectors, it has high efficiency for cooling and heating systems.

从以上方面，山东力诺瑞特新能源有限公司经过精细研发，成功推出中温真空管太阳能集热器，可在太阳能制冷和采暖系统上高效应用。



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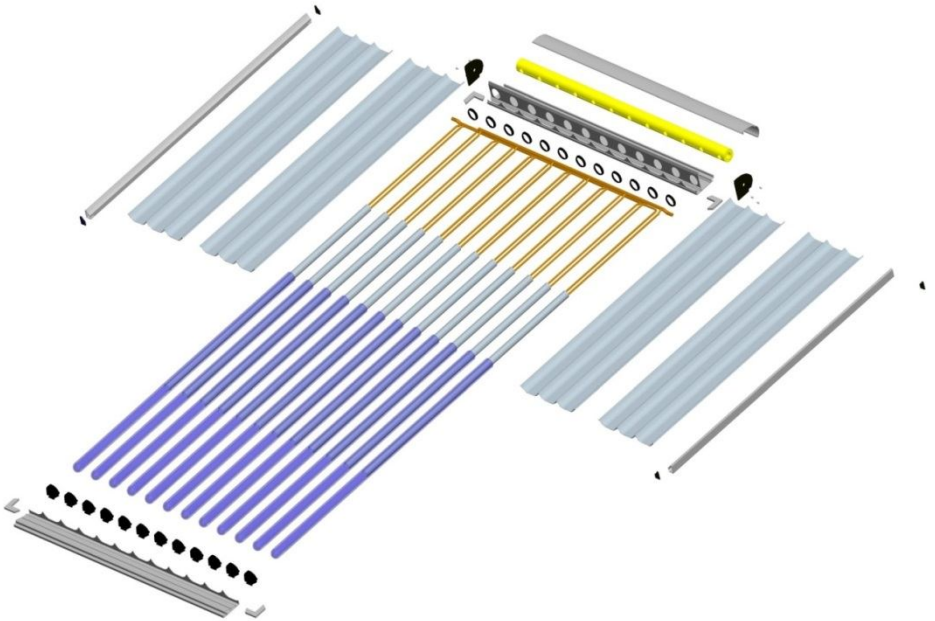
Medium collector main components

- Medium temperature all-glass vacuum tubes中温全玻璃真空管
- Nickel-plated copper regulator 镀镍铜调节器
- Aluminum fin铝翼
- CPC reflectors CPC反光板
- Aluminum frame铝型材边框



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Q / A

Why is it suitable for small and medium sized air conditioning systems?

为什么适合应用于中小型空调系统？

Because this product are characterized by the following:

因为以下的这些产品特点：

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Character 1

1. Medium temperature all-glass vacuum tubes:

(1) Titanium coating from the inventor of the vacuum tube - Professor Yin Zhiqiang at Tsinghua University, High absorpttance and very low emittance, good stability of titanium metal.

(2) the anti-reflection process on the cover tube , the transmittance increased by 2-3%.

(3) double-effect getter keep long-lasting vacuum property

中温全玻璃真空管的优越性能：

（1）钛金涂层来自于真空管的发明人——清华大学殷志强教授，钛金属稳定性好。

（2）罩玻璃管增加减反层处理，使透射比增加2-3%。

（3）双效吸气剂使夹层真空维持更久

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Character 2

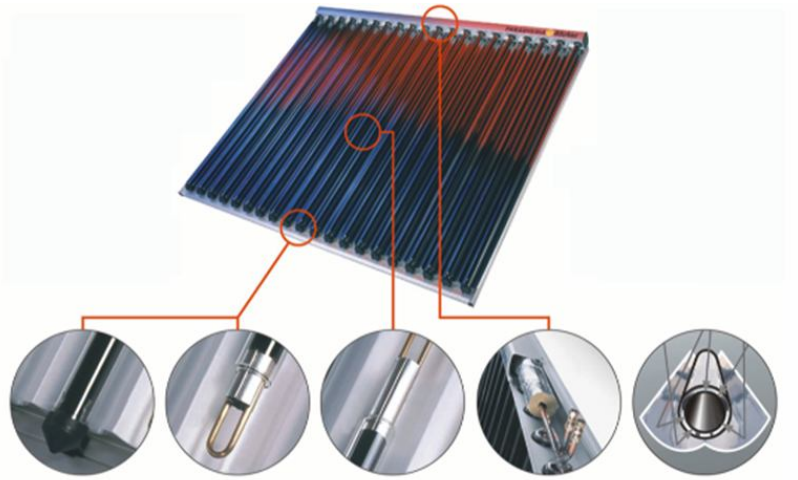
2. nickel plated copper:

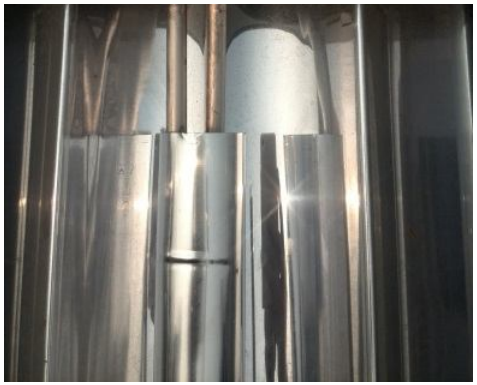
Long term high temperature will oxidize surface of copper pipe, which affect the heat transferring

The thin nickel metal surface protective layer, which makes it non-oxidizable and stable performance of the collector

2、镀镍的铜管：

铜管长期高温工作会出现氧化问题，表面铜锈影响热量的传输，在铜管表面增加很薄的镍金属保护层，使其长久不氧化，性能稳定





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Character 3

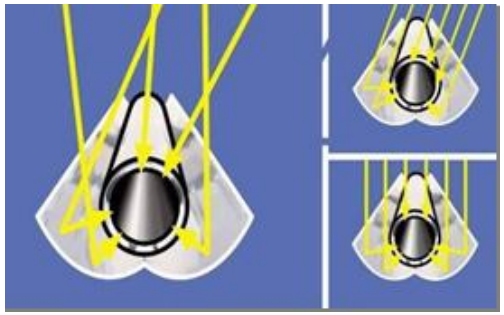
3、CPC反光板：CPC reflectors reduce thermal loss

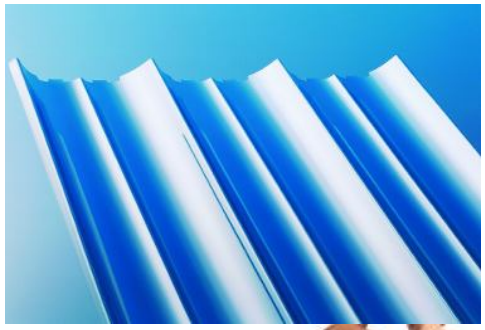
Large portion of heat loss is caused by evacuated tube emitting, application of CPC reflectors directly reduce the number of evacuated tubes, which minimize the heat loss.

我们知道集热器的热损很大部分来自于真空管的热发射，CPC反光板的应用可以减少集热管的支数，从而减少热损。

self cleaning features at raining day,then area with less sandstorm doesn't need frequent maintenance.

下雨天自动清洁，不是经常有风沙的地区，清洁维护可以很少。





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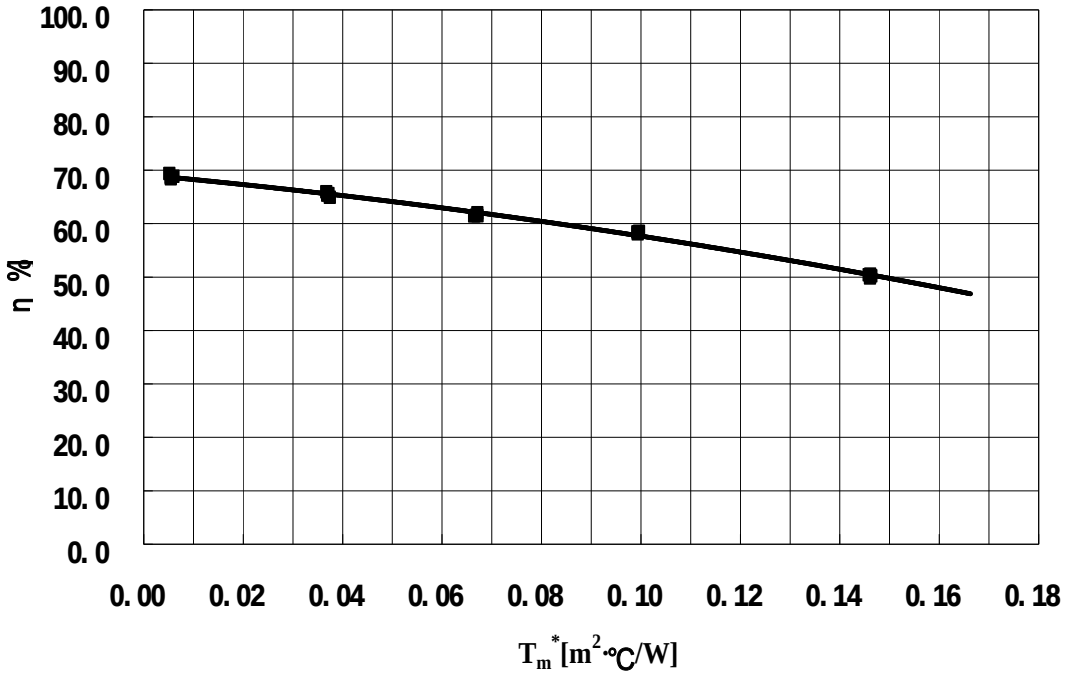
Efficiency curve



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Its level

Chinese top experts team inspected: the collector operation temperature is high to 150℃，thermal performance reach to the top position in the world

中国顶级的专家团队鉴定：

该产品填补了150℃温区的空白，

达到国际领先水平

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"Industrial Green Power" program

- Based on the results of the product research, Linuo Paradigma has developed industrial thermal systems technology from 2010.
- Linuo Paradigma's "Industrial Green Power" program, started at 2011,which actively promotes solar energy in solar cooling and heating, as well as applications in kinds of industrial area

基于该产品的研究成果，力诺瑞特同时发展了太阳能工业热力系统技术，在山东省节能办公室、山东省太阳能协会的支持下，启动力诺瑞特“工业绿动力”计划，积极推动太阳能在空调制冷和采暖，乃至于工业领域的应用。

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main projects of solar cooling

solar air-conditioning applications, the main projects include:

在太阳能空调应用方面，主要的项目有：

●Zero Carbon house solar air conditioning at Linuo Paradigma,2010,115㎡

力诺瑞特零碳馆太阳能空调

●China Academy of Building Research，320㎡,2013

中国建筑科学研究院

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Conclusion

This medium temperature vacuum tube solar collector is suitable for small sized solar air conditioning system

As a non-tracking concentrating collector, there is no concern about tracking accuracy, the operating temperature range is suitable for the needs of solar air conditioning unit, the great achievement is that its design to improve efficiency and ensure stability .

中温真空管太阳能集热器非常适合中小型化的太阳能空调系统，作为聚光非跟踪集热器，其工作过程中没有跟踪精度的问题，工作温度范围非常适合太阳能空调机组的需求，主要的是其设计从提高效率、保证稳定方面下了非常大的功夫，且取得了很好的效果。

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