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**ETN MGT WG**

**Recuperator Chapter for ISO 19372**

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**5.14 Microturbine Recuperator**

**5.14.1 General**

A recuperator can be integrated in the microturbine thermodynamic cycle to recover the exhaust gas heat in order to preheat the compressed air before it enters the combustor.

The microturbine cycle generates high pressure air flows and hot combustion gases. The air pressure is typically between 2.5 and 10 bars, while the exhaust gases are expanded to the atmosphere pressure.

It is the responsibility of the microturbine manufacturer (OEM), the packager, the operator or assimilated to warrant that the recuperator fulfils safety and applicable standards according to its type and integration.

**5.14.2 Recuperator types**

As a guideline, the different recuperator types that can be used are:

* **Plates heat exchanger**, with primary and, potentially secondary heat transfer surfaces;
* **Shell and tube heat exchanger**;
* **Regenerative** heat recovery with fixed or mobile core.

**5.14.3 Recuperator integration**

Different integration levels between the microturbine engine and the recuperator can be adopted (see Figures 4,5,6 below using a consistent legend with current Figure 3):

* **Fully integrated**:
	+ The air (17) exits the compressor (4) and feeds directly the recuperator (15). No duct, external to the turbomachine envelope, is required between the compressor (4) and the recuperator core (15).
	+ Similarly, the air (18) exits the recuperator (15) and feeds directly the combustor (16). No duct, external to the turbomachine envelope (8), is required between the recuperator core (15) and the combustor (16).
* **Partially integrated**:
	+ At least one duct (20), outside the turbomachine envelope (8), is needed to feed either the recuperator (15) with compressed air (21) or the combustor (16) with preheated air (18) exiting the recuperator core (15).
* **Dissociated**:
	+ The air exits (17) the compressor (15) and is guided to the recuperator core (15) via a ‘cold air’ ducting system (20).
	+ Similarly, the air (24) exits the recuperator (15) and is guided to the combustor (16) via a “hot air” ducting system (22).
	+ Ducting system typically integrate welded or bolted flanges, tubes, elbows, bellows, compensators….

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| **Figure 4 – Fully integrated recuperator** |
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| **Figure 5 – Partially integrated recuperator** |
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| **Figure 6 – Dissociated recuperator** |

**5.14.4 Fully integrated plates recuperator**

Recuperator based only on **fully integrated plates heat exchanger** architecture presents complex structure whose sizing criteria are more severe than pressure resistance. Those criteria are creep, fatigue, but also effectiveness and pressure drop requiring complex honeycomb type structure. Consequently, those recuperators are excluded from the PED and will be designed to achieve the required tolerable level of risk defined by a risk assessment analysis.

**5.14.5 Recuperator exhaust gas ducting**

Cold and hot gas ducts (Ref. 11 & 23 on Figures 6) are subjected to pressure really close to the atmosphere (< 1 bar relative). Then, these ducts are excluded from the PED and safety relevant components.

**5.14.6 Recuperator air ducting**

Cold and hot air ducting system must be studied as regards to the PED requirements, and classified accordingly, depending on their volume and pressure design points.

**APPENDIX : FIGURE 3 OF THE ISO19372 – 2015**

