

GROUND POWER UNIT

GA Model

TECHNICAL DESCRIPTION





1. MAIN FEATURES

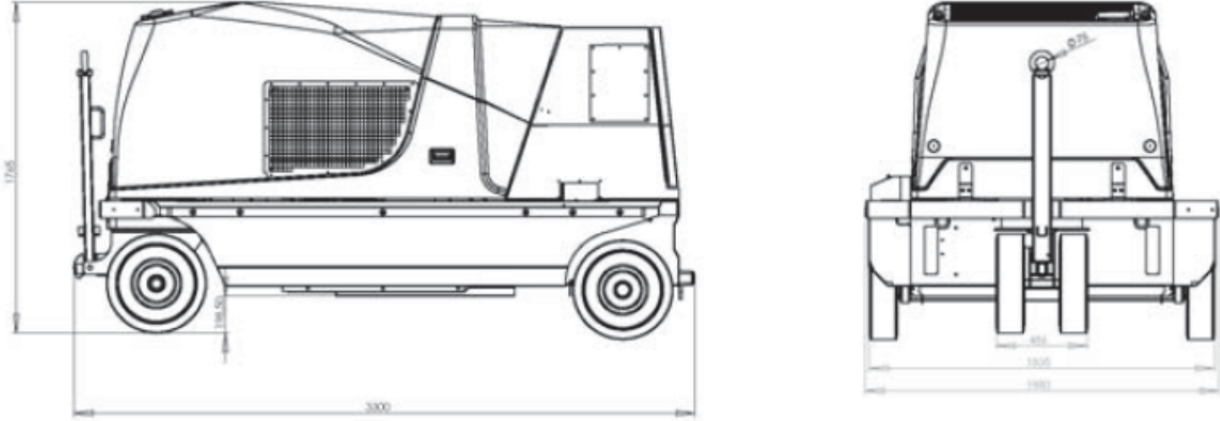
				GA90		GA120		GA150		GA180	
				1714 rpm	2182 rpm	1714 rpm	2182 rpm	1714 rpm	2182 rpm	1714 rpm	2182 rpm
Diesel Engine type	Cyl.	Emission	Power (kW)								
Deutz TCD2013L04-2V	4	COM IIIA F*	114	■	-	-	-	-	-	-	-
Deutz TCD2013L06-2V	6	COM IIIA F	174	-	-	■	-	■	-	-	-
Deutz TCD2013L06-4V	6	COM IIIA F	260	-	-	-	-	-	-	■	■
Deutz BF4M1013EC	4	COM II F	110	■	■	-	-	-	-	-	-
Deutz BF6M1013E	6	COM II F	137	-	-	■	■	-	-	-	-
Deutz BF6M1013EC	6	COM II F	166	-	-	-	■	■	■	-	-
Deutz BF6M1013FC	6	COM II F	197→225	-	-	-	-	-	-	■	■
Cummins QSB 4,5	4	COM IIIA V	120	■	■	-	-	-	-	-	-
Cummins QSB 6,7	6	COM IIIA V	165	-	-	■	■	■	■	-	-
Cummins QSL 9	6	COM IIIA V	245	-	-	-	-	-	-	■	■
Perkins 1106D	6	COM IIIA V	129	-	■	-	-	-	-	-	-
Perkins 1106D	6	COM IIIA V	169	-	-	-	■	-	■	-	-
Iveco NEF45TM2	4	COM II F	120 (161)	■	■	-	-	-	-	-	-
Iveco NEF67TM2	6	COM II F	148 (198)	-	-	■	■	-	-	-	-
Iveco NEF67TM3	6	COM II F	176 (241)	-	-	-	-	■	■	-	-

**Note: Emission letter "F" means Fixed speed engine certification and "V" means Variable speed engine certification.
(See 3.1.1 Engine emission standard)*

Alternator											
Guinault AS250L200	28 poles – brushless	■	-	-	-	-	-	-	-	-	-
Guinault AS250M150	22 poles – brushless	-	■	-	■	-	-	-	-	-	-
Guinault AS280L240	28 poles – brushless	-	-	■	-	■	-	■	-	-	-
Guinault AS250L250	22 poles – brushless	-	-	-	-	-	■	-	-	■	-

Electrical									
Permanent Power at cos φ = 0,8 (KVA)	90	90	120	120	140	150	180	180	
Number of 400 Hz 115/200V Output (*second output option available)	1*	1*	2	2	2	2	2	2	
Overload 25% - 5min	■	■	■	■	■	■	■	■	
Overload 10% - 10 min	■	■	■	■	■	■	■	■	
Transient performances according to MIL STD 704E/EN2282/ISO6858	■	■	■	■	■	■	■	■	



	GA90	GA120		GA150		GA180		
General								
Weight (KG) / (engine depending)	2.100 kg		2.300 - 2.500 kg			2.700 kg		
Dimensions (mm)	L 3300 X W 1880 X H 1765 mm							
Battery System	24 Volts (2x12V/125 Ah in serial)							
Fuel Tank	280 litres (autonomy>8 hours up to 20 hours)							
Sound Level <85 dB (± 2 dB) at 1 meter (engine depending)	■	■	■	■	■	■	■	■
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Options
28 Vdc output - 800 A continuous / 2400 A peak - ATR Limitation
Sound Insulation : <69dB at 7m & <80dB at 1m (standard 2003/10/CE – 89/391/CE)
Engine Pre-Heating supplied by batteries for Cold Temperature (<-10°C)
Engine Pre-Heating supplied by 50/60Hz mains for Extreme Low Temperature (<-25°C)
Automatic Engine oil refilling system 12,5L
Double Electrical Insulation (DSF 400 standard)
Sand Wind Protection
GPU anti-towing Safety when cables are connected to Aircraft
GPU integrated in Push Back Tractors
Truck Mounted GPU (Mercedes, Iveco...)
Additional outputs such as 56Vdc, 37V AC or 50 Hz-220V.
Low speed alternator 28 poles 1714rpm
Special colour
Special outputs: 2x28Vdc in parallel or independent, 28/56Vdc, 270Vdc, 115Vdc single phase



2. TCO CALCULATION

2.1. Rotating speed

The fuel consumption of GPU is directly linked to the engine rotation speed.

However, the number of possible speeds to create 400Hz for a GPU engine is limited to the number of pairs of poles that can be built into the alternator according to the formula:

$$\text{Engine speed} = \frac{24000}{\text{Number of pair of poles}}$$

Where 24000 is the equivalent of 400Hz with a simple dipole
pp = pairs of poles

Results:

10 pp	→ 2400 rpm
11 pp	→ 2182 rpm
12 pp	→ 2000 rpm
13 pp	→ 1846 rpm
14 pp	→ 1714 rpm
15 pp	→ 1600 rpm
16 pp	→ 1500 rpm

Other parameters must also be taken into account such as the response time of the engine which is necessary to reach the level of the norms ISO 6858 or EN 2282. Indeed, while decreasing the speed of the engine to save fuel, the inertia of the engine is also reduced and therefore the response time (transients).

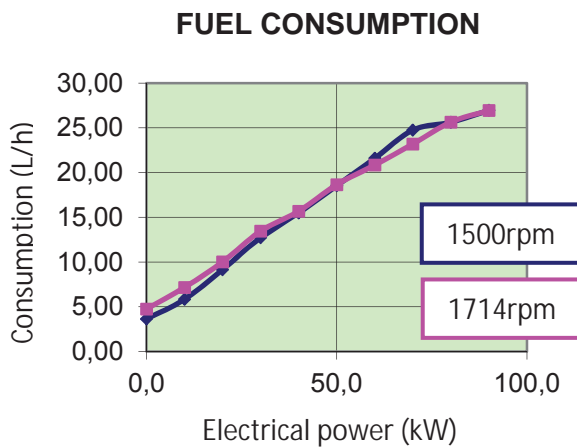
GUINAULT has selected 1714 rpm (14 pair of poles alternator) because it is the best performance / fuel consumption compromise. The fuel economy is low when we look at lower speed (1600 and 1500rpm) whereas the transients are constantly deteriorating.

In addition, in order to create the necessary power at very low speed (1500 rpm), the torque of the engine must be increased to compensate the lack of inertia (Power = Torque * Speed). Consequently, the engine pistons hit stronger and create more vibrations that may cause mechanical issues on the GPU on a long term basis.

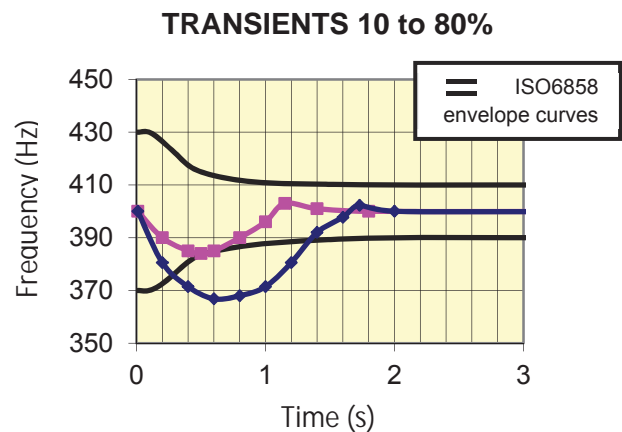
Conclusion:

The GPU rotating speed selection is a compromise between performance (transient / response time) and fuel consumption. 1714rpm appears to be the best compromise.

2.2. Measures on 90kVA GPU with DEUTZ TCD2013L04-2V



The fuel economy at 1500rpm at low load is mainly due to the lower ventilation power requested. From 50kW load, the inertia of the engine enables less fuel consumption for 1714rpm.



The frequency transient measurements show that the 1714rpm response time complies with the ISO 6858 tolerances whereas the 1500rpm has not enough inertia to react.

2.4. Fuel savings during no load time

According to our study made with a recorder on GPUs in 3 international airports over Europe:
Around 30% of the time, GPUs are running but don't provide any power to the aircraft.

As a consequence, GUINAULT implemented the anti-towing option including cable receptacles on each side of the unit to plug the cables when they are not in use (see picture➡). A sensor inside detects if the cables are stored or not. When the GPU engine is started and the cables are in storage position, then the engine is driven at idle speed 750rpm to enable fuel savings during no load time (3 L/h instead of 5L/h).



Conclusion:

A rotation speed of 1714 rpm allows a significant reduction of the fuel consumption, noise frequency and increase the unit's lifetime within the acceptable response time according to European standards. The use of anti-towing option represents about 450 L savings per year (for use 1500 h/year).



3. DESCRIPTION

3.1. Engine

3.1.1. Engine emission standard

GPUs sold in the European Union must follow the diesel emission standards legislation in force at the moment of the delivery of new products. In Europe, two different certifications are available for engine manufacturers to be allowed to sell engines: **Variable speed and constant speed** certifications. The tables below shows the actual emission standards schedule depending on the engine power (kW):

Variable Speed	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
75 - 129,9 Kw GPU 90kVA	COM II Variable Speed			COM IIIA Variable Speed					COM IIIB Variable Speed		COM IV	
130 - 560Kw GPU > 90kVA	COM II Variable S.		COM IIIA Variable Speed					COM IIIB Variable Speed		COM IV		

Fixed Speed	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
75 - 129,9 Kw GPU 90kVA				COM II Constant Speed				COM IIIA Constant Speed				
130 - 560Kw GPU > 90kVA				COM II Constant Speed				COM IIIA Constant Speed				

The constant speed certification is more expansive and more difficult to obtain because special measurements and tests have to be done at a precise engine speed (rpm) whereas the variable certification is made for all speed rates between two values (ie between 1500 and 1800rpm). At the moment, the norm in force for engine of 90KVA GPU certified at fixed speed is COM IIIA and variable speed is COM IIIB and for engine >90KVA GPU certified at variable speed is COM IV.

In addition, the certification at fixed speed is more interesting because there is at the moment no limitation in time before to go to the next step (COM IIIB). The norm COM IIIA is also more advantageous because it is the last step before particle filter and/or catalyser become mandatory and increases the complexity and maintenance cost of diesel engines.

3.1.2. Engine types

The fitted engine is a DEUTZ, IVECO, PERKINS or CUMMINS engine (s. technical features across the range page 2). The speed regulation is ensured by an electronic regulator EMR (Deutz), ECM (Cummins) or GAC (Iveco). All selected engines are 4 or 6 cylinders, diesel. They comply with the latest emission standard. (*Technical data : see page 2*)



DEUTZ Engine



EMR (DEUTZ)



CUMMINS Engine



ECM (CUMMINS)



IVECO Engine



GAC (IVECO)

3.2. Alternator and Electrical output

3.2.1. 400 Hz – 115/200 V Generation

The new range of Guinault alternator are very compact and high efficient. The integral ventilator ensures a very good cooling in tropical or desert surroundings. (*Technical data: see page 2*)



Performances of the 400Hz generation :

Nominal power:	See table page 4
Overloads:	110 % of rated output for 10 min 125 % of rated output for 5 min
Rated Voltage:	115/200 V +/- 1%
Frequency:	400 Hz +/- 0.5%
Voltage regulation:	Electronic regulator GUINAULT type RS525
Output	115/200V-400Hz output, length 10 m, fitted with standard Stanag 3303 aircraft connector
Harmonics :	< 3%
Transient performances:	according to MIL STD 704E / EN2282 / ISO 6858
Recovery time NO LOAD / FULL LOAD (Voltage)	80 ms



3.2.2. 28 Vdc Generation



A 28 Vdc output can be offered as an option.

The 28Vdc Transformer Rectifier Unit (TRU) is fitted with 2 transformers (Start / Delta), 2 high efficiency cooling ventilators, and very robust diodes.

The Voltage / current are controled and monitored by RS533 Guinault electronic PCB.

Performances of the 28VDC TRU :

Voltage (when unloaded) :	28,8 VDC
Current:	800 A permanent 1.200 A during 3 minutes 1.800 A during 3 seconds 2.500 A instantaneous peak
Voltage regulation:	Electronic regulator GUINAULT PCB type RS525 + Electronic monitoring GUINAULT PCB type RS533
Output :	One 10 metres long cable, complete with aircraft's connector

The ATR limitation for the 28V (1275 A) continuous generation operated with a commutator makes it possible to comply with the ATR specifications.

The guinault GPU makes it possible to use simultaneously the 28 Vdc and 400 Hz generations.

3.3. Safeties

The Guinault electronic system protects the users and the ground power unit against:

Engine Safeties	115V/400Hz Safeties	28Vdc Safeties
<ul style="list-style-type: none"> ▪ Low oil pressure ▪ High coolant temperature ▪ Clogged Air filter ▪ Battery charging fault ▪ Over speed 	<ul style="list-style-type: none"> ▪ Over voltage ▪ Under voltage ▪ Over frequency ▪ Under frequency ▪ Overload 	<ul style="list-style-type: none"> ▪ Over voltage ▪ Under voltage ▪ Overload

The trouble-shootings display is done through red LEDs placed on the sequency card. Guinault has chosen this type of display because it is robust and easy to use.

3.4. Electrical box / Control panel

The GPU is equipped with:

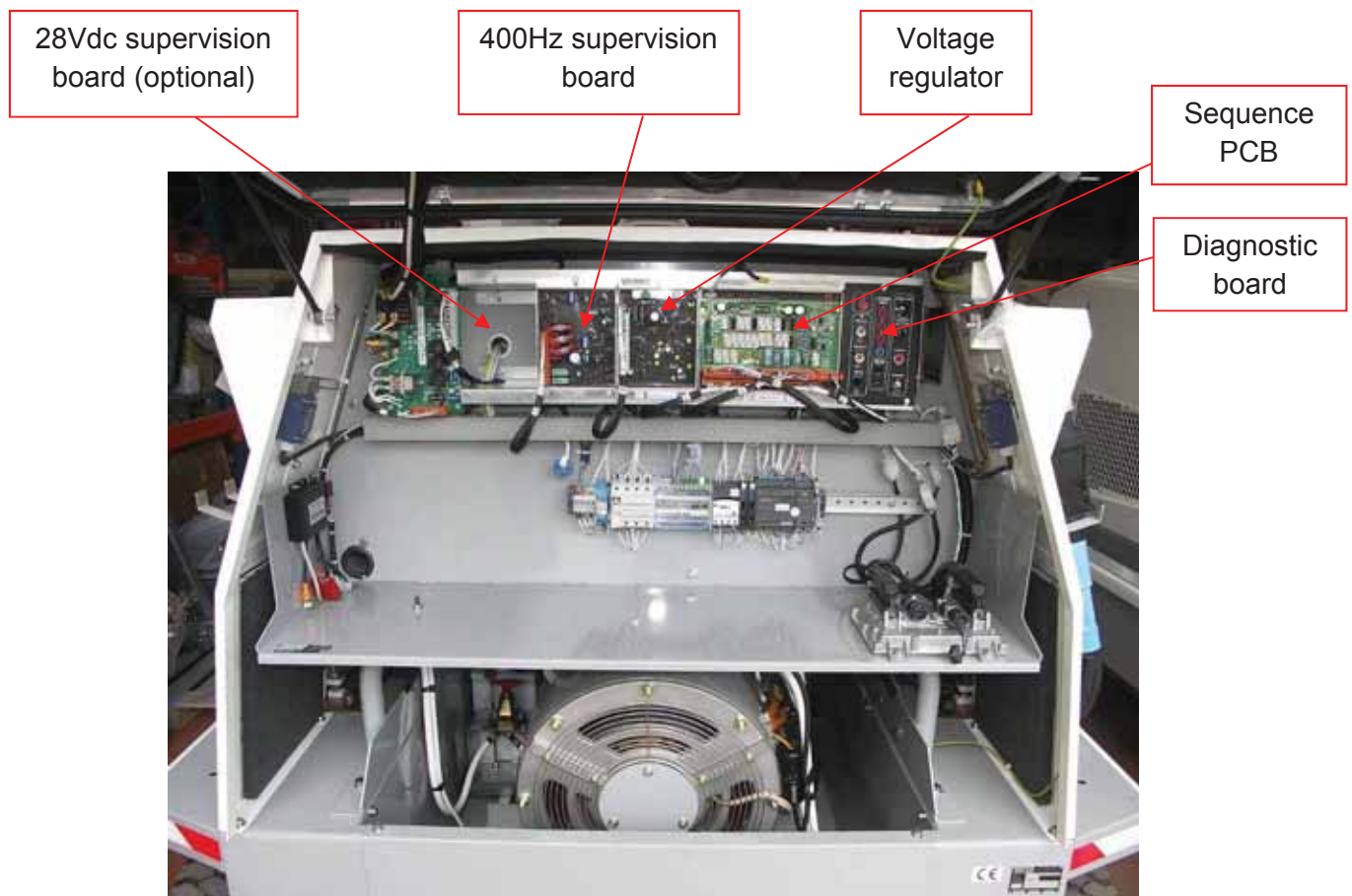
- A complete and weatherproof control panel, easy accessible, with permanent indications in English or in local language when required.



The control panel is fitted with robust and big push button, easy to operate in all weather conditions. Analogical display allows a quick check by the user of the good functioning of the unit.

- A set of electronic Print Circuit Boards, designed and manufactured by GUINAULT, including:

- sequence board with relays
- voltage regulator with line drop compensation function
- 400 Hz supervision board (over-under frequency, over-under voltage, overload)
- 28 VDC supervision board (over-under voltage, overload).



These electronic control boards are designed to have a very high level of detection, with an integrating system which enables to control the GPU based on the applicable standards.

All electronic boards are designed and manufactured by GUINAULT.

3.5. Extra-Protection of Chassis and Fuel Tank

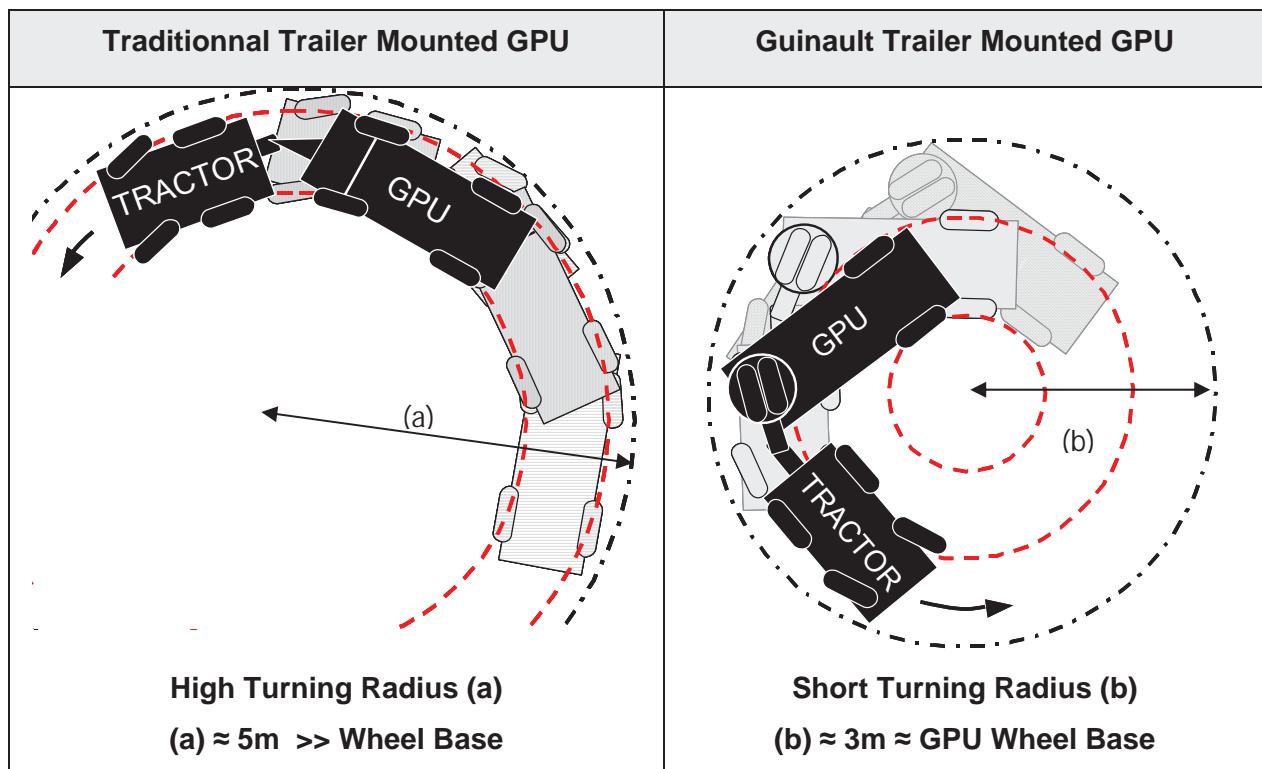
Guinault installs on GPU an Extra-Anti-corrosion system dedicated to hot area and/or with high sulfur contained fuel (>50ppm). This option includes :

1. Galvanization of the GPU chassis in order to avoid corrosion (treatment in the steel material for better efficiency (not only on surface))
2. Polyester canopy for total anti-corrosion system
3. Strong plastic Polymer fuel tank recovered by galvanized steel. High sulphur contained fuel reacts with water to create sulphuric acid. The sulphuric acid attack the traditional steel fuel tank to create corrosion (in fuel tank and in the fuel circuit (pump, filter...)). The use of Polymer fuel tank permits to avoid the corrosion and increase significantly the fuel circuit system life time
4. Removable fuel tank for easy maintenance and cleaning



3.6. Manoeuvrability

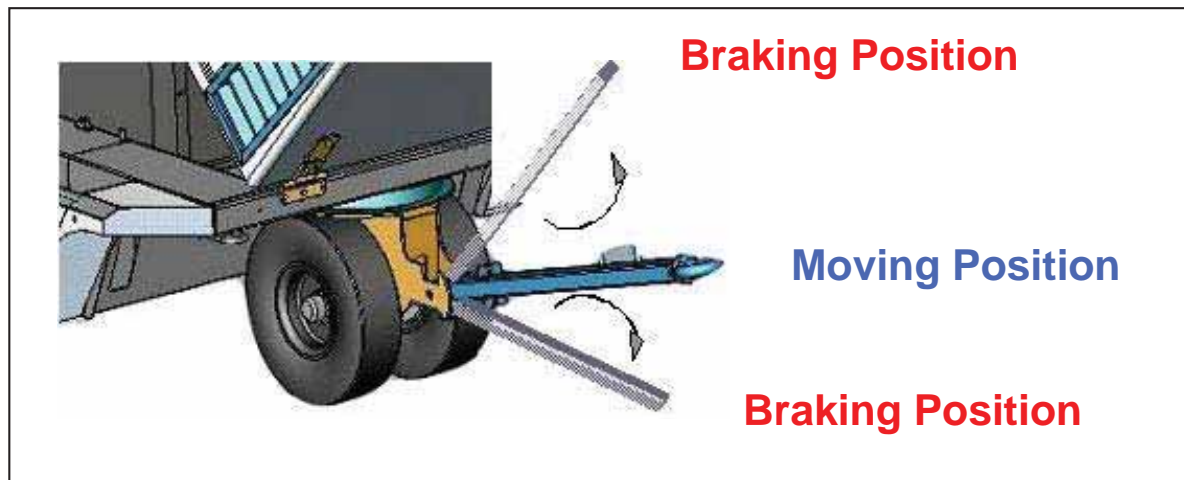
The ground power unit steering is ensured by a steering turn table guaranteeing reliability, robustness and a great manoeuvrability (see schema below).



The chassis includes two passages for fork-lift truck as well as four anchorage rings.



The braking is ensured by high and low positioning of the tow bar.



GPU anti-towing Safety when cables are connected to Aircraft (option)

A specific sensor detects movements of the GPU. If the cable plugs are not located on the plug receiver fixed on the GPU, visual and noise alarm indicates the risk that the plugs are still connected to the aircraft (risk of damage on the aircraft)



3.7. Canopy

The access for maintenance can be done by swinging the polyester canopy towards the front, allowing a total access to the diesel engine. The access to the control system part is done by opening a door at the rear.

4 beacon lights (red lights) are fitted on the four top corners of the canopy.

The ground power unit is soundproofed. Two Cable compartments are located on each side of the unit enabling a rapid and easy cable deposit. Those cable compartments are detachable from the main chassis allowing easy repair or replacement



3.8. Sand filters (option)

Guinault designed since many years GPU for Gulf region like UAE, YEMEN, KOWEIT, QATAR, OMAN, KINGDOM OF SAUDI ARABIA... Following our experience, the most important point in this region is the cooling capacity of the GPU to avoid overheating. Sand-wind or dusty, in reaction with humidity and Kerosene atmosphere creates Paste/gum which clog engine radiator and decrease its cooling efficiency. To avoid this phenomena, GUINAULT includes protection Filter against sand-wind dusty/sandy area with clogging safety. This protection protects the engine radiator and the air changer cooler against sand. **This permits to preserve engine performances and avoid the risk of overheating**



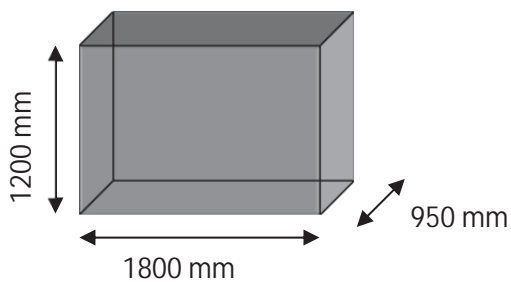
4. AVAILABLE OPTIONS

4.1. GPU truck mounted

On demand, the GPU can be mounted on several types of trucks (Mercedes, Iveco or any other types). This integration is preferably made in factory but can also be done at customer's site.



The GPU can also be integrated on a Push-Back tractor. In this case, the GPU is fitted in a fixed/compact chassis.



4.2. Other options

Additional outputs 400Hz or
28Vdc, 56Vdc, 37 Vac, 50Hz-220V



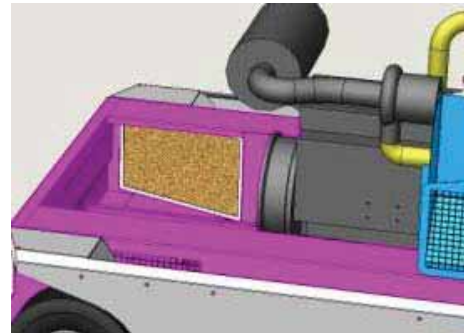
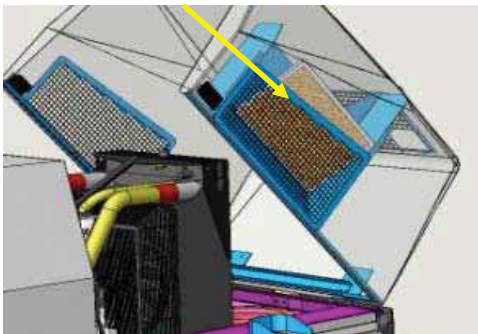
Full automatic oil fill in system



Fire extinguisher



Protection Filter against sand-wind dusty/sandy area with clogging safety. This protection protects the engine radiator and the air changer cooler against sand. This permits to preserve engine performances and avoid the risk of overheating



And also:

- Any Pre-heating devices for use at very low temperatures
- Any specific marking or lights
- Sound level reduction <80dB @ 1m : Protects the users, saves “training-information & individual protections” costs according to 2003/10/CE – 89/391/CE standard
- Any other specific requirements....





5. CONTACT

Please don't hesitate to contact us if you need any information and visit us on our website @ www.guinault-lebrun.com

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