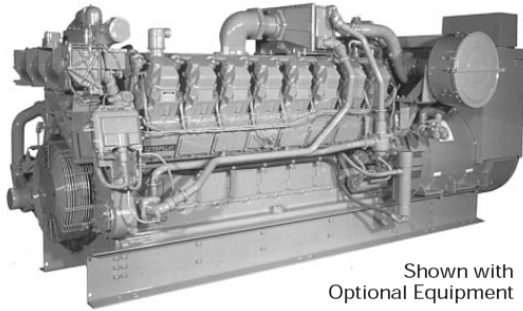


ANEXO 1



Shown with  
Optional Equipment

## Gas Generator Set

**G3516**  
1800 rpm  
1040 kW 60 Hz

Standby Power

### CATERPILLAR® ENGINE SPECIFICATIONS

V-16, 4-Stroke-Cycle Spark-Ignited  
Bore — in (mm) ..... 6.7 (170)  
Stroke — in (mm) ..... 7.5 (190)  
Displacement — cu in (L) ..... 4210 (67.4)  
Aspiration ..... Turbocharged-Aftercooled  
Compression ratio ..... 11:1



### FEATURES

- **CATERPILLAR® FACTORY PACKAGE**  
Factory designed, assembled, and tested. Supported by Caterpillar parts and labor warranty through your local Caterpillar dealer.
- **DIESEL STRENGTH BUILT IN**  
Blocks, crankshafts, liners, and connecting rods are common with higher loaded Cat® diesel engines. Robust design provides prolonged life at lower gas engine loads.
- **ELECTRONIC IGNITION SYSTEM WITH DETONATION SENSITIVE TIMING**  
The Caterpillar Electronic Ignition System (EIS) provides optimized spark timing for all operating conditions. Timing is automatically controlled to maintain continuous detonation protection.
- **LOW EXHAUST EMISSIONS**  
2.0 gram/bhp-hr NO<sub>x</sub>. Lower emissions are achievable for selected applications; consult your Caterpillar dealer.

### CATERPILLAR® SR4B GENERATOR

Type ..... Static regulator, brushless excited  
Construction ..... Single bearing, close coupled  
Three phase ..... Wye connected  
Insulation ..... Class H  
Enclosure ..... Drip proof IP/22, guarded  
Alignment ..... Caterpillar pilot shaft  
Overspeed capability ..... 150%  
Waveform ..... Less than 5% deviation  
Voltage regulator ..... 3-phase sensing with  
Volts-per-Hertz response  
Voltage regulation ..... Less than ± 1%  
Voltage gain ..... Adjustable to compensate for  
engine speed droop and line loss  
TIF ..... Less than 50  
THF ..... Less than 5%

### CATERPILLAR CONTROL PANEL

**24 Volt DC Control**  
Terminal box mounted  
Vibration isolated  
NEMA 1/IP 22 enclosure  
Electrically dead front  
Lockable door  
Generator instruments meet ANSI C-39-1

**Voltages Available**  
**60 Hz**  
240, 480

(Adjustable a minimum of ±10%)  
Other voltages available – consult your Caterpillar dealer.  
Some voltages require derating.

### STANDARD EQUIPMENT

Engine  
Air cleaner with service indicator  
Breather, crankcase  
Cooler, lubricating oil  
EMCP II, generator control, engine start/stop logic  
Filter, lubricating oil, RH  
Flywheel housing, SAE No. 0  
Governor, Woodward 2301A  
Ignition system, Caterpillar ES  
Instrument panel, RH intake manifold pressure, intake manifold temperature, oil pressure differential, exhaust pyrometer, and thermocouples  
Jacket water heater  
Lifting eyes  
Manifold, exhaust, watercooled  
Paint, Caterpillar yellow  
Protection devices  
Pumps, aftercooler water, lubricating oil, jacket water, gear driven

Rails, mounting, 13 inch  
SAE standard rotation  
Thermostats and housing  
Torsional vibration damper  
Valve, 24V gas shutoff  
Generator  
All metal components are plated or painted  
Optimum winding pitch for minimum total harmonic distortion  
Self excitation (300% short circuit current)  
Standards: meets or exceeds the requirements of IEC 34-1, NEMA MG1-22, BS4000, VDE 0530, UTE 5100, CSA 22.2, ISO 9529-3  
Three-phase sensing automatic voltage regulator  
VR3 voltage regulator  
Wet layer wound rotors individually tested to 125% overspeed; prototypes to 150% @ 338° F (170° C)  
Windings coated with a fungus-resistant varnish

### OPTIONAL EQUIPMENT

Engine  
Battery chargers  
Battery, rack, and cables  
Air inlet adapters  
Customer Communications Module (CCM)  
Exhaust fittings  
Muffler  
Power takeoffs  
Pre-lube pump  
Lube oil  
Generator  
DVR - Digital Voltage Regulator, adjustable volts/H, regulation for large block loads. Diode monitor, under- and over-voltage protection  
Extra dips and bases of insulating resins  
Manual voltage control  
RFI filter - BS4000/IEC, VDE 87510/84 A2 Level N, BS800 standards, and MIL-STD-461B (conducted, radiated, and susceptibility VR3F for enhanced transient response and block loading  
Permanent magnet excitation

### ENGINE AND GENERATOR CONTROLS

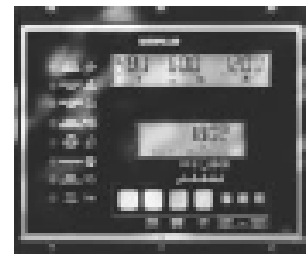
The EMCP II comes complete with many control features competitive manufacturers only offer as options.

**Standard Features**  
Adjustable purge cycle from 6-20 seconds (factory set at 5 seconds)  
Auto start-stop engine control with programmable safety shutdowns  
Cooldown timer, adjustable from 0 to 30 minutes  
Cycle cranking, with adjustable crank/rest periods of 1 to 60 seconds  
Delayed ignition (magneto) "kill" after gas valve is closed. Five second delay  
Emergency stop button

Flashing LED indicators for protection and diagnostics, including: low oil pressure, high coolant temperature, low coolant level (when optional coolant sensor is installed), overspeed, overcrank, emergency stop, fault shutdown, spare fault alarm

Generator voltage adjust potentiometer  
Indicator/display test switch  
LCD digital readout for: engine oil pressure, coolant temperature, engine rpm, system DC volts, generator AC volts and amps, and generator frequency  
NEMA VP 22 enclosure  
Programmable for engine to shutoff or engine to run  
Spare alarm and fault inputs for customer use

**Optional Features**  
Alarm modules and remote annunciators to meet NFPA 99 or NFPA 110 codes  
Auxiliary relay  
Coolant loss sensor  
Customer interface module  
Dustproof enclosure  
Frequency adjust potentiometer  
Panel lights  
Reverse power relay  
Synchronizing modules



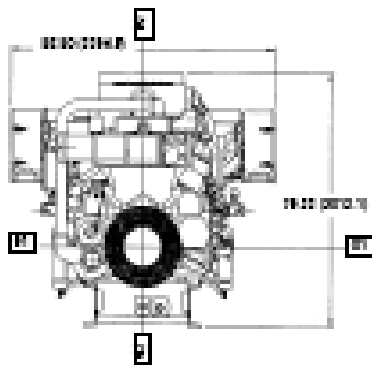
## G3516 GAS GENERATOR SET



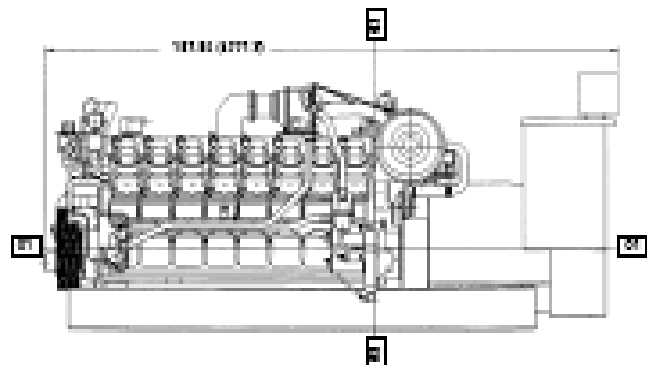
### TECHNICAL DATA

G3516 LE Standby Power Gas Generator Sets — 1800 rpm		
Power Rating @ 0.8 PF without Fan	kW kVA	1040 1300
Generator Frame Size		693
Engine Lubricating Oil Capacity	gal	106
System Backpressure (Max Allowable)	in water	27
Exhaust Flange Size — (Internal Diameter)	in	7.1
Length	in	187.9
Width	in	86.8
Height	in	79.2
Shipping Weight	lbs	20 560
Engine Coolant Capacity with Radiator	gal	
100% Load Fuel Consumption (100% load) with Fan per ISO 3046/1: +5%, -0% tolerance	BTU/bhp-hr	7899
Motor Starting (35% voltage dip)	kVA (volt)	2626 (480)
Combustion Air Inlet Flow Rate	ft <sup>3</sup> /min	3436
Exhaust Gas Flow Rate (at stack temp)	ft <sup>3</sup> /min	8583
Heat Rejection to Aftercooler	BTU/min	9746
Heat Rejection to Exhaust (total)	BTU/min	54 853
Heat Rejection to Jacket Water (total)	BTU/min	58 557
Heat Rejection to Atmosphere from Engine	BTU/min	7155
Heat Rejection to Atmosphere from Generator	BTU/min	2821
Exhaust Gas Stack Temperature	Deg F	1603
Duration for Engine Altitude — 3.5% per 500 feet above 2% per 10° F above	hr Deg F	4000 77
* Note: For permitting see TMI data.		

**FRONT VIEW**



**SIDE VIEW**



**01** Centerline of Crankshaft

**03** Rear Face of Cylinder Block

**02** Centerline of Engine

See general dimension drawing 127-9351 for additional information.

Note: General configuration not to be used for installation.

Dimensions are in in (mm).

**RATINGS DEFINITIONS AND CONDITIONS**

Ratings are based on SAE J1349 standard conditions of 29.61 in Hg (100 kPa) and 77° F (25° C). These ratings also apply at ISO 3046/1, DIN 6271, and BS 5514 standard conditions of 29.61 in Hg (100 kPa) and 81° F (27° C); and API 7B-11C standard conditions of 29.38 in Hg (99 kPa) and 85° F (29° C) also apply.

Ratings are based on dry natural gas having a low heat value of 905 Btu/ft<sup>3</sup> (35.22 MJ/m<sup>3</sup>). Variations in altitude, temperature, and gas composition from standard conditions may require a reduction in engine horsepower.

Turbocharged-aftercooled ratings apply to 4000 ft (1225 m) and 77° F (25° C). For applications which exceed these limits consult your Caterpillar dealer.

Standby — Output available with varying load for the duration of the interruption of the normal source power. Fuel stop power in accordance with ISO 3046/1, AS 2789, DIN 6271, and BS 5514.

Additional ratings may be available for specific customer requirements. Consult your Caterpillar representative for details.

ANEXO 2

#### MÁQUINAS

- Grupos Motores Diesel
- Grupos para Máquinas de Trabalho
- Grupos Motores a Gás
- Proteção de Energia
- Motores Industriais
- UPS
- Motores Marítimos
- Energias Alternativas
- Cogeração
- Soluções Especiais
- Partidas
- Simulador
- Acessórios
- Block Heater
- Peças e acessórios
- Consulte o nosso catálogo de motores 2011!



## MOTORES

### Motors

#### 925H LE

##### Características Gerais

Potência elétrica	1678 kW
Potência elétrica	1842 kW
Rendimento eléctrico	88 %
Taxa de compressão	15:1
Rotação	1800 rpm

##### Dimensões

Peso	1200 kg
Comprimento	5441 mm
Largura	2071 mm
Altura	2120 mm

##### Consumíveis

Peso máq. óleo	100 máq
Consumo Máq. Natural	200.0 g/kWh
Consumo Máq. Natural PCI	2740 kW

##### Óleo

Capacidade do Carter	480 L
Consumo Médio Óleo	400 g/h

##### Distribuição

- Distribuição - Fiat (Dodge/Chrysler) (100 kW)
- Distribuição - Isuzu (Isuzu) (100 kW)

Os dados apresentados devem ser considerados com meramente informativos e sujeitos a alteração sem aviso prévio.

## ANEXO 3





Make cold out of waste heat

▶ *ago congeló*

**ago**  
energía + an[agen]

One Step ahead.

## Cold out of heat

### ago congeló

From small plants to industrial large scale plants – with us, your project is in good hands. In the area of refrigeration plant construction, the dominant fields of activity over the past years have been: split units, screw-type water chillers, turbo water chillers and absorption chillers in complex interconnections with diverse heat generators.

On the basis of a cooperation with ILL Dresden, AGO AG Energie - Anlagen exclusively disposes of a highly interesting product in the area of absorption for cold generation below 0°C.

AGO Congelo, the ammonia/water absorption chiller for temperatures below 0°C.



up to - 30°C

Modular structure

Reliability

### Why cold out of heat?

#### Ecological aspects:

- Less energy consumption as opposed to the conventional ammonia generation
- Reduction of CO<sub>2</sub> emissions
- Reduction of noxious emissions
- It's possible to use waste heat flows for the generation of thermal energy for miscellaneous cold demands
- Substitution of premium electric energy by "inferior" thermal energy in the form of waste heat

#### Economical aspects:

- Reduction of the life cycle costs due to lower operational costs:
  - Lower consumption of premium electric energy
  - Lower electric power input
  - Lower maintenance and repair costs
  - Long life cycle owing to fewer moving components
  - Reliability: superior availability

### Areas of application

- Food and beverage industry
- Large bakeries
- Breweries
- Fruit and vegetable cooling
- Milk cooling
- Deep freeze and cold storage
- Fish processing facilities
- Chemical and petrochemical industry
- Gas turbine air cooling

### Business activities

Construction and delivery of ammonia/water absorption chillers with refrigerating capacities of 50 kW to 1,000 kW per module in an effective temperature range of up to - 10°C.

Construction and delivery of cascade absorption chillers with refrigerating capacities of 50 kW to 1,000 kW per module in an effective temperature range of up to - 30°C.

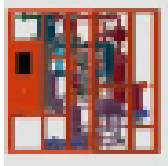
Design and erection of energy network systems with integrated absorption chillers.





### Demonstration of the thermo-dynamic basis

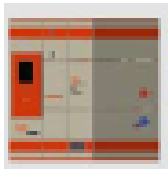
According to the basic laws of thermodynamics heat itself only flows from the higher to the lower temperature level. Refrigeration systems have ever convey heat from a lower temperature level (cooling load) to a higher one. This process requires energy.



### Heat energy instead of electric energy

For generating cold electrically driven compressor-type chillers are applied by default. In times of high energy costs a cost-saving alternative can be offered:

- The absorption chiller powered by waste heat.
- It works according to the principle which has already been known since the early 19th century.
- Now that the conscious economical use of energy also has become an important criterion in terms of refrigeration engineering the importance of an absorption chiller powered by waste heat is increasing.

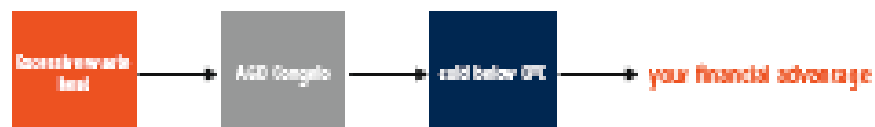


The following figures illustrate the chiller's energy flows and the absorption chiller's mode of operation by means of the pressure-temperature-diagram.

### Usable heat sources

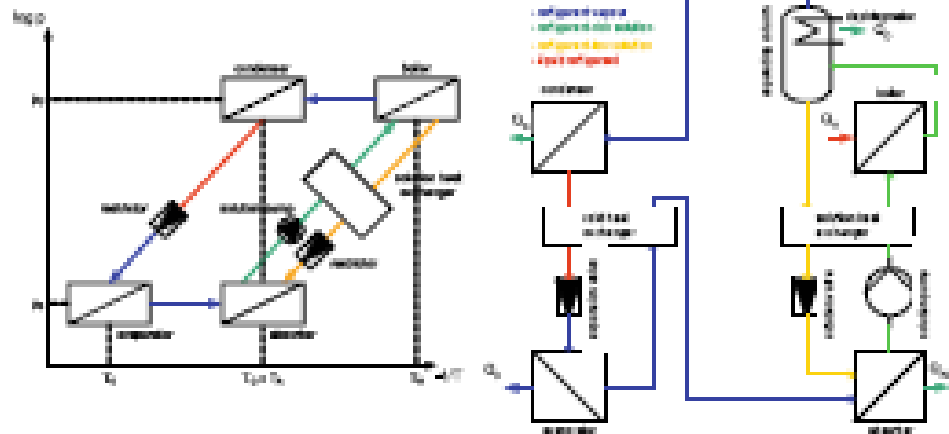
- Industrial/waste heat in the form of waste steam and thermal oil
- CHP waste heat
- Waste heat from thermal post-combustion
- Solar heat
- Biomass plants and biogas plants

### Mode of operation



energy

Low maintenance costs



### Mode of operation

The absorption chiller's refrigerant (ammonia) absorbs a heat flow  $Q_0$  and evaporates in doing so. The refrigerant vapour is absorbed by a liquid solution (aqueous ammonia solution) which has a higher dissolving power than the refrigerant. The thereby released heat flow  $Q_3$  needs to be dissipated.

A pump with a low energy input conveys the incompressible solution with the refrigerant to the higher pressure level.

By adding heat  $Q_1$  to the boiler (activation of the process) the refrigerant escapes from the solution and is liquefied in the condenser by dissipating heat  $Q_2$ .

The refrigerant cycle and the solution cycle are closed by means of relief valves (pressure valves and solution valves). For increasing the energetic efficiency the solution cycle is installed in a solution heat exchanger.

The ammonia refrigerant has excellent thermo-dynamic characteristics. Therefore, it is one of the classic refrigerants which has already been used by Linde for their refrigeration systems and these that made available for a wide variety of applications. To this day, it has not lost its significance. Despite its toxicity and flammability the chillers with ammonia as refrigerant are safe according to state-of-the-art technology.



## Advantages of the absorption chiller

- Powered by low temperature waste heat from DMC
- Utilization of "free" waste heat
- Possibility of trigeneration in connection with combined heat and power plants (CHPs)
- Fully automatic operation
- Favorable part load behavior at a proportional consumption of the required heat input
- Simple operation
- Generation of effective temperatures of up to -20°C
- COP adjustment to requirements



## Advantages compared to compression-type chillers

- Low susceptibility to failure due to simple design
- Low power consumption, 85 % preservation of primary energy
- Is not subject to the regulation on fluorinated greenhouse gases
- Low sound power level and structure-borne sound propagation (low noise level, no vibrations)
- Utilization of natural refrigerants (GWP and ODP = 0)
- Oil-free refrigerant



## Advantages compared to water/lithium bromide absorption chillers

- Cold temperatures <math>-20^{\circ}\text{C}</math> are possible

## Advantages of the AGO design

- Modular structure
- Compact design through use of plate heat exchangers
- Less refrigerant required
- Easy to be installed
- Individual design allows for insertion in existing systems (trigeneration)
- Outdoor installation no problem



availability

Easy construction

### Profitability

The profitability of an ammonia/water absorption chiller can only be calculated by taking the following criteria under consideration. It is always necessary to consider the whole system in each individual case.

Costs for refrigeration plants depend on design parameters, such as:

- Refrigerating capacity
- Heating medium temperature (depends on the refrigerant's temperature)
- Refrigerant's temperature
- Re-cooling temperature or cooling water temperature
- Rectification efforts, etc.

The profitability of a NH<sub>3</sub> absorption chiller can only be calculated taking into consideration:

- the exact conditions of the location
- the current operating costs (such as gas price, water costs, sewage costs and electricity costs)
- the heat price, electricity credit in case of CHP waste heat (no generation bonus)
- the costs of saved electricity and operating costs
- the costs saved due to the lower electrical connection power
- the determination of the plant to be compared
- the redundancy necessity, etc.

### Purchase or Contracting

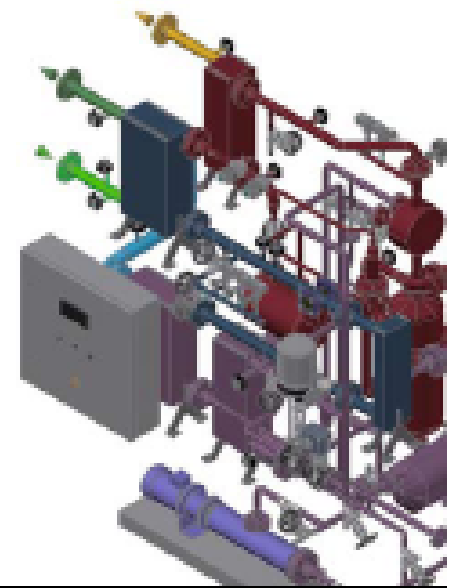
When buying it, the plant will be designed, installed and taken into operation by AGO AG. However, there is the possibility of using this innovative technology via Contracting. In such case, the plant will be erected and operated by AGO AG on its own and at its own expense.

### Customer's benefit

- Supply of cold at fixed terms
- No maintenance efforts
- No investment to be made by the customer

### Business services

- Consulting, design, construction, operation
- Heat construction
- Coproduction
- Heat and refrigeration systems
- Ventilation systems
- Media supply
- Contracting
- Plant operation
- After sales service
- Emissions management





## **AGO AG**

The company, founded in 1980 with headquarters in Kulmbach, is a specialist in the area of innovative and efficient energy supply plants for industrial customers. AGO AG focuses on the three business segments project development and implementation, operation of facilities as well as service and consulting. The company's core competences are biomass cogeneration plants, combined heat and power plants, construction of heat and refrigeration plants, trigeneration as well as Contracting, location studies / location development, consulting on energy efficiency, raw material and fuel management as well as emissions trading management round off AGO's business model.

AGO's energy supply plants represent efficiency, reliability and technological competence.

## **Contact**

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[www.agoag.de](http://www.agoag.de)



ANEXO 4



































