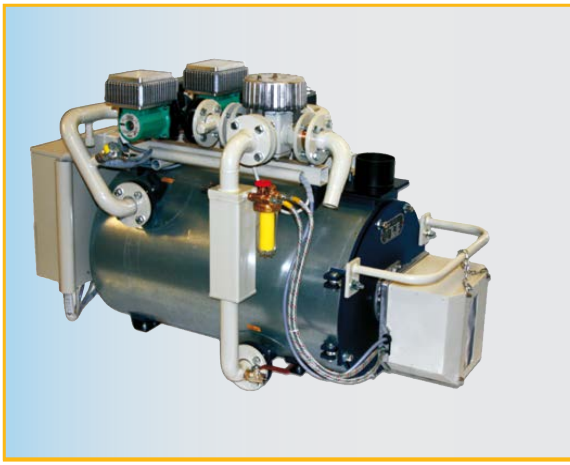
AST Gruppe
Angewandte System Technik

#1 Class Supplier to German Rail

AStop-Idle

Self-Powered Idling Stop Technology for Diesel Engines
with integrated handbrake sensor



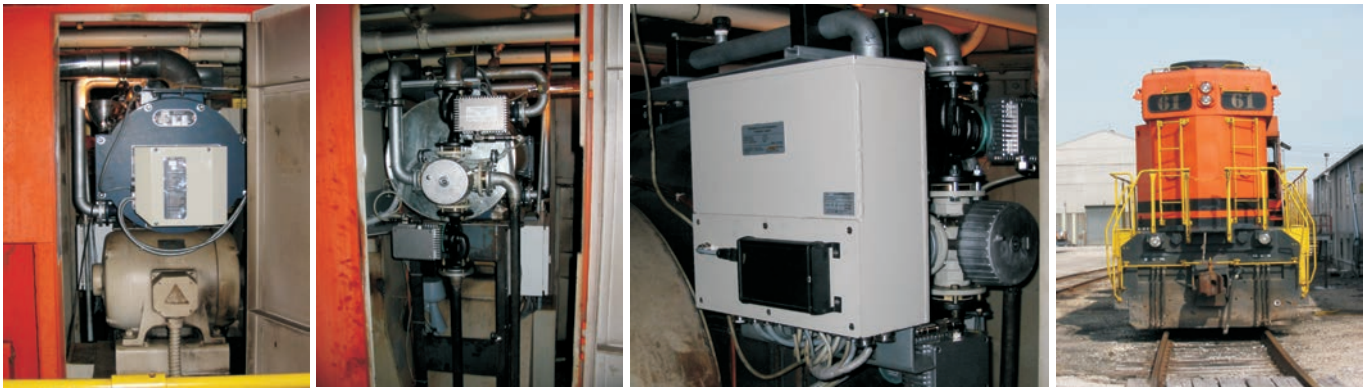
A STop-Idle

Fuel Operated Heating System for Diesel Engines

A.S.T. has equipped more than 4,000 diesel locomotives with A**ST**op-**I**dle Technology world-wide in the last 20 years. The fuel operated heating system is fully independent and protects the locomotive automatically by heating the coolant in the engine as well as the engine oil and air compressor. It´s function is to stop low and high idling to maintain ideal engine temperatures year-round down to sub-zero temperatures and to extend AESS (auto engine stop/start) shutdowns which are effective for 6-8 months of the year only. As an inherent system benefit to railways, locomotives that fail to start are now protected from dumping of its water or frost damage.

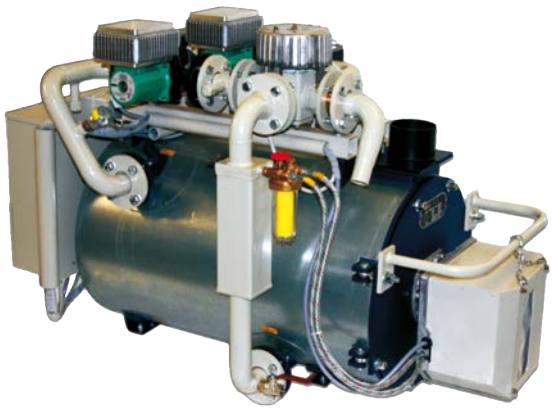
A.S.T. Idling Stop Technology System is a listed as an EPA Smart-Way verified technology for locomotives. It reduces operating costs by saving approximately 95% to 97% fuel consumption by idle reduction. Simultaneously it reduces green house gas emissions and the surrounding area noise level, extends the operational life of the locomotive and cuts down on maintenance costs. The system core is a high efficient, isolated and rail-designed heat exchanger, equipped with a two-stage burner with integrated fuel pre-warming. Two low powered frequency controlled circulation pumps and a temperature controlled 4-way mixing valve, provide a "Two-Cycle System" in order to meet optimum heating strategies. The heat exchanger has its own safety controlling logic, a high frequency ignition and numerous built in safety features to ensure the system is stable from the sea level up to mountainous areas. The diesel fuelled heating system operates at more than 90% efficiency and meets all pollution-free requirements of industrial oil heating systems and is relatively noiseless.

Meeting the railways need for reliability, the minimum design life of the system exceeds 15 years of rugged service with ultra-low annual maintenance . There are numerous systems that have been in service for more than 20 years on German locomotives.



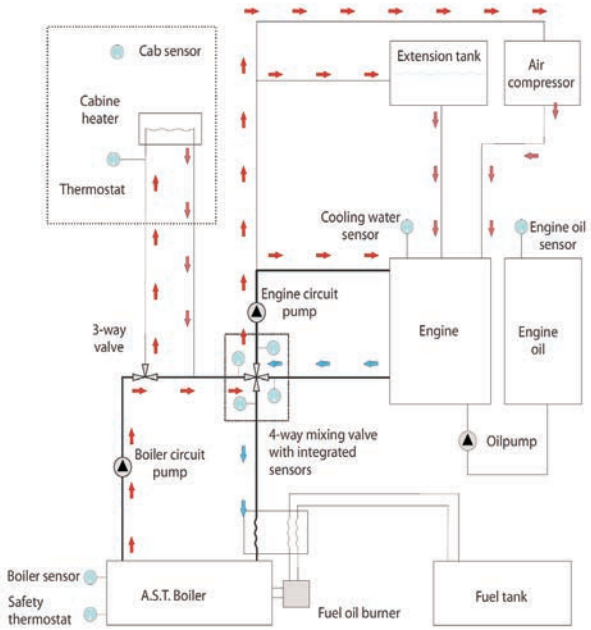
*Installation example - 50 kW A**ST**op-**I**dle Technology System at EMD SD18*

Technical Key Data



Example: 50 kW horizontal

Heat output	35 ~ 50 kW or 50 ~ 90 kW Boiler mounting – either horizontal or vertical
Operating voltage	24 VDC, 64 VDC, 110 VDC Voltage converters and stabilizers according to railway's requirements
Protection class	up to IP 65 environmental
Ambient temperature	efficient to -40°C (-40°F)
Environment	Relatively noiseless <50dB, >90% efficient
Installation	Customised to locomotive model and customer specification

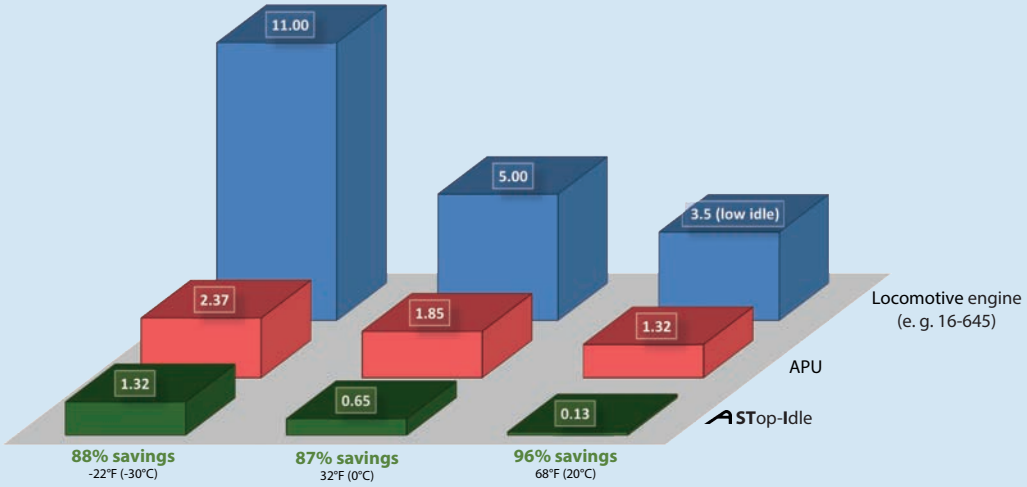


Heating Circuit

The drawing shows the integration of the ASTop-Idle Technology System into the cooling circuit of a diesel engine. With this configuration the locomotive cab, fuel tank and engine oil can be warmed by the engine heating system. Several built in sensors and at specific locations provide the necessary monitoring of the complete engine and the system heater.

Integration for a typical wet/dry cooling system e.g. EMD 645 engine, GE AC4400

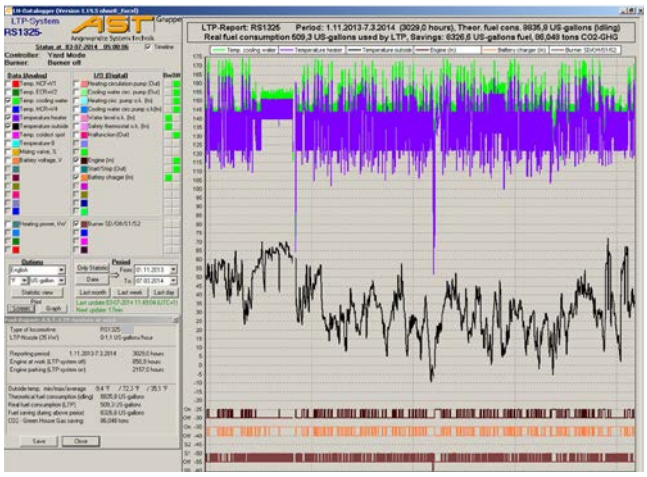
Fuel Consumed in US gal. Hourly to Ambient Temperature



Locomotive engine (e.g. 16-645)
APU-Diesel
ASTop-Idle

The ASTop-Idle fuel consumption is 0.13 to 1.32 US gal/h depending on ambient temperature which is 88-96% less than the locomotive idle fuel consumption. APUs cannot yield those savings do not work silent and require frequent maintenance.

Fuel Consumption



Example - Report of a RS1325 locomotive

Example of a Fuel Saving Report

This screen-shot is a RS1325 locomotive fuel report for a "winter season" of Nov 01, 2013 to March 07, 2014. During the total running recorded 3,029 hours, the locomotive had been parked for 2,157 hours. The ambient temperature dropped to -9° F (-22° C). The coolant water temperature was maintained higher than 110° F (43° C). The fuel consumption of the ASTop-Idle for this within 2,157 hours was 509.3 US gallons. As the AESS alone does not allow shutdowns in the winter months, if the locomotive would have been parked idling during this period, the fuel consumption would have been 8835.8 US gallons. This example shows the ASTop-Idle Technology System saved 8326.6 US gallons and reduced 86.048 tons of green house gas emission in 2,157 hours reducing its parked idle time by 71%.

Design

The system components of the **ST**op-**I**dle are designed for minimal servicing and energy consumption in diesel locomotives. Thus the variable speed circulation pumps have integrated inverters that improve efficiency, endurance and reliability. The boilers are extremely robust and efficient. All electronic components (e.g. process control system, mini cab control terminal) are built for the locomotive environment and adequately designed for vibrations, a wide range of ambient temperatures and voltage spikes and fluctuations expected during normal locomotive operation.

The microprocessor control unit of the **ST**op-**I**dle Technology System is built in an IP65 EMV-protected 19" electronic-box, equipped with an integrated wide range power supply, I/O cards to connect all external and internal I/O devices such as temperature limiter and temperature sensors. The system comes with a mini cab control terminal for operator and maintenance. The complete system is equipped with a diagnostic "Built in Test equipment" (BITE) connected to an integrated I/O modem for storing, downloading and sending relevant operation data to a central processing server using a GSM modem.

The system can be installed either horizontally or vertically for the best location depending on the usable space on the locomotive. It monitors the coolant water temperature, ambient temperature, the coldest spot temperature and other important signals such as the locomotive battery voltage, air brake pressure and oil as required. The system operates based on the actual conditions and system programmed parameters.

GPRS Data Logger, Operation Mode

The onboard GPRS Data Logger allows remote monitoring of all system parameters. Fuel saving reports can be accessed through the web and operating data as well:

- Battery voltage / state of charge
- Temperatures (cooling water, ambient, boiler)
- System specific data (burner status, malfunctions)

If a malfunction occurs an alarm notice can be sent by e-mail or sms (text messaging).

The microprocessor system contains a flash memory capacity for data storage of a few months recording every second and saves the necessary operating BITE-data like the status of burner, the ambient temperature, the air pressure and other important information. The system monitors up to 16 analog and 16 digital input/output signals of the system and the locomotive. This data is also used to calculate the diesel fuel consumption of the **ST**op-**I**dle Technology System, the fuel savings of the locomotive and the emission reduction.

In addition, the data will show the status of the locomotive and the system's heating operations. The system also measures the locomotive battery voltage to ensure charging it in relevant situations. When the locomotive is operating or stationed in a GPRS-Cellular Network Area, it is possible to view the realtime data online and download this data from the locomotive. Additionally it is possible to remotely upload data or program instructions to the **ST**op-**I**dle Technology System on the locomotive.

The **ST**op-**I**dle Technology System normally starts operating after the locomotive has been parked. After the AESS engine shutdown, when the ambient temperature is lower than 24° C (75° F) and the coolant water has dropped below 40° C (105° F) , the 4-way valve separates the boiler water from engine water circle and starts heating. This "Two-Cycle-System" allows it to retain a few gallons water in the boiler circuit so it can be heated quickly above the dew-point of approximately 47° C (116° F) to avoid condensation in the combustion chamber and reduce emissions. Once the water temperature in the boiler circuit reaches 50° C (122° F), the 4-way valve will gradually open to allow the engine cooling water to flow and to be maintained at to keep a temperature of about 40° C (105° F) in the engine circuit. A frequency controlled water pump in each circuit operates with optimum efficiency and maintains the temperature in the locomotive water circuit at nominal Yard mode or crew selected Road mode levels.

Additionally the **ST**op-**I**dle Technology System monitors the "coldest spot in the locomotive" (usually at the air compressor or other periphery device) via an installed additional temperature sensor to keep it above 32° C (90° F) to avoid leaking of fittings and ensure the lubrication oil within a comfortable temperature range for the locomotive.

Normally when the battery voltage drops to a certain level, say 62 V, the **ST**op-**I**dle Technology System sends out a "battery low" output signal to the AESS system to restart the engine for necessary battery charging. The **ST**op-**I**dle Technology System only uses about 0.3 kW average per hour power from the locomotive battery during system operation.
So, in summer conditions the system could operate up to 48 hours without the battery dropping below the 62 V threshold, for a successful engine restart. As illustrated, with the TEG option, in winter months with lower main battery capacity, this extended shutdown time can also be achieved with the self-generating power for it's operation and to maintain charging of the locomotive battery before an engine restart signal is necessary.

System Components

1

Circulation pump with integrated inverter
short-circuit protected, jolt-free running, high breakaway torque, safety cut-off if pump is locked, IP 65

2

Low-pressure hot water boiler
thermal output 35 ~ 50 kW or 50 ~ 90 kW
efficiency > 90 %,
Hinged front panel for rapid access to the flue for cleaning

3

Two-stage oil burner
autonomous process control, service-friendly construction, integrated inverter for ventilator, IP 54

4

4-way mixing valve
integrated temperature sensor in all four circuits, position indication, emergency switchover to manual operation, IP 65

5

Process control system
data recorder function, build in test equipment (BITE) for permanent self-monitoring, extremely reliable, IP 65

6

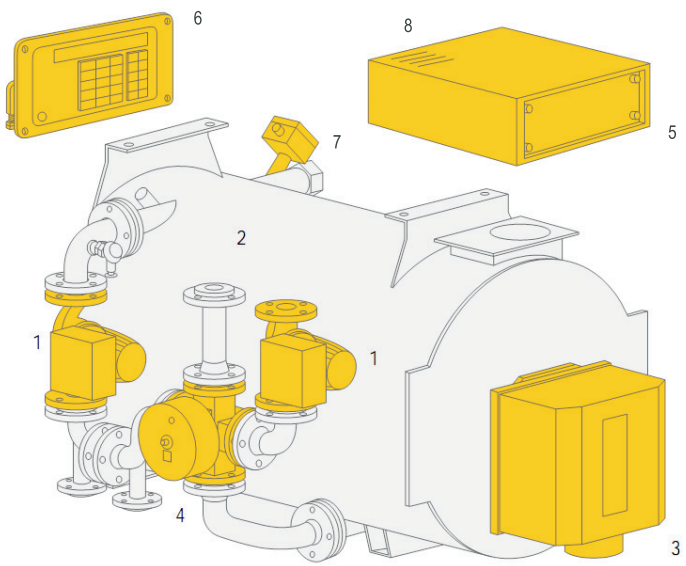
Mini-terminal
handling of the system interface, menu driven commands, crew information,any installation location in the vehicle

7

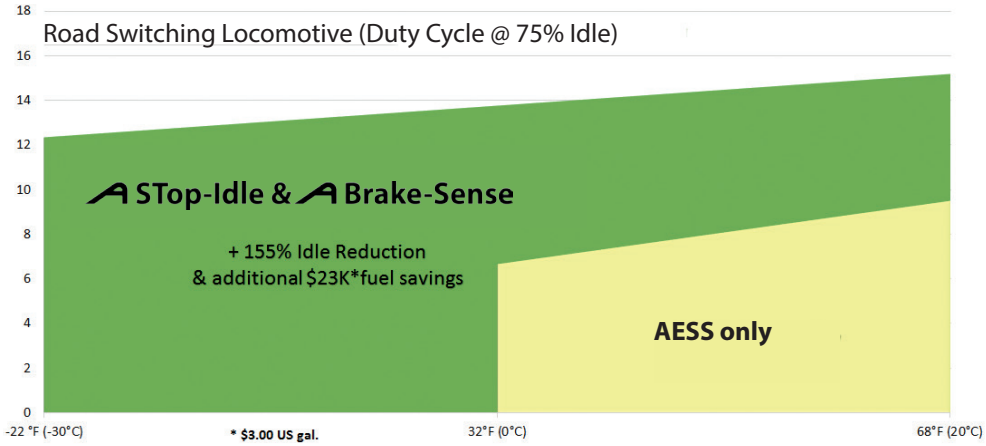
Temperature sensors
various thermostats for system operation, IP 65

8

GPRS data logger
remote monitoring of the system, fuel saving reports, alarm notices, IP 65



STop-Idle & Brake-Sense Idle Reduction Increase versus AESS only (hours per day)

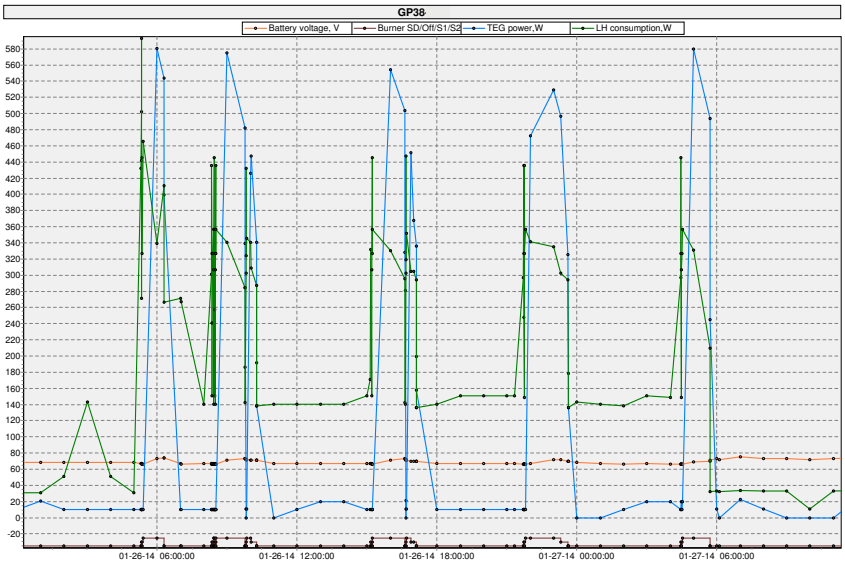


Whereas AESS can only operate at ambient temperatures above 32°F (0°C) the **STop-Idle** Technology System can yield idle reduction also at sub zero temperatures. Using **STop-Idle** Technology System including **B**rake-**S**ense can reduce idling time up to 15 hrs/day for a road switching locomotive. There is no longer a need for AESS to start up for ambient temperature and main reservoir air pressure.

AESS only
STop-Idle & **B**rake-**S**ense

* NEW INOVATION

STop-Idle with Integrated TEG Modules



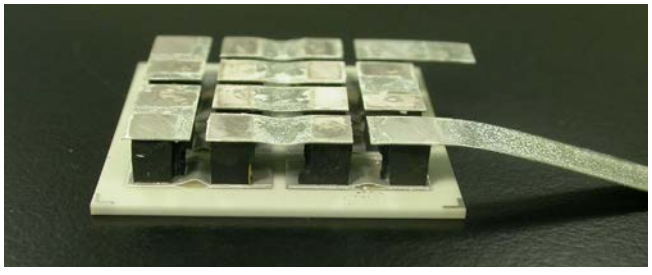
This screenshot shows the data of the battery voltage (orange line), the burner status (brown line), the TEG produced power (blue line) and the consumption of the engine (green line) during the period of one day.

*Installation example 50 kW **STop-Idle** system with integrated TEG modules on an EMD GP38*

Due to the low total power consumption (< 300 watts) the system can run continuously for two days from the charged main battery. During longer layovers and especially at sub-zero ambient temperature, more frequent engine starts are needed to ensure battery capacities for cranking.

Now with a remarkable new innovation of a thermo-electric generator (TEG) which can be included with the **STop-Idle** Technology System, batteries can remain fully charged without the need an engine restart, a voltage supply plugin or engine driven power generators. A.S.T. engineers have developed the new heating system with an integrated self-generating TEG that supplies up to 1.5 kW of electrical power to power itself when running and charge the locomotive batteries.

The TEG not only extends the locomotive shutdown time dramatically and maintains optimum battery health when needed at colder temperatures this solid state option functions without any additional diesel fuel, saving more fuel efficiently.



TEG modul

Brake-Sense

In order to increase the safety of a parked locomotive, it is highly recommended to monitor the handbrake applied status especially on a majority of locomotives without electronic handbrake sensing. A.S.T. therefore has designed a ruggedized Handbrake-Sensing-Unit (**B**rake-**S**ense) that monitors the handbrake applied status.

It is optimally located directly to the brake cylinder lever to measure the correct handbrake applied force in order to process a handbrake "applied signal" when a locomotive specific programmed force has been reached and to prompt information about deviations. AESS systems can utilize this information and a handheld reader is also available for maintenance personnel.

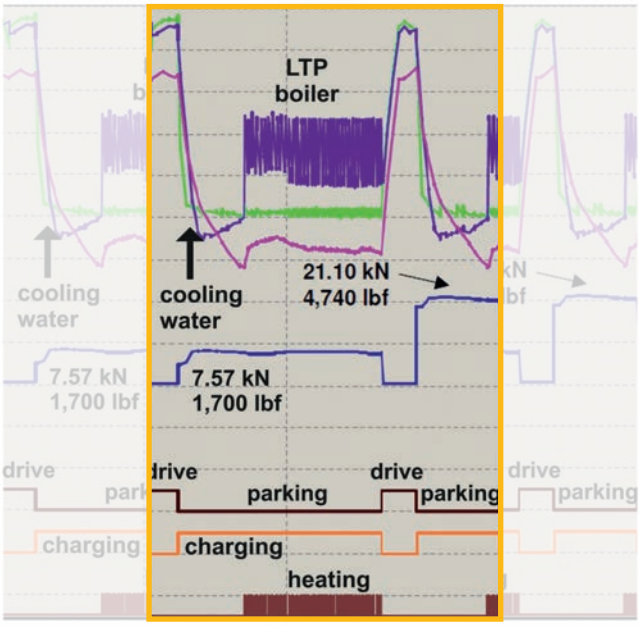
It complies with AAR AESS Specification S-5502, when the status of the handbrake "applied signal" is known, the locomotive will not have to restart due to low MR (main reservoir) or low independent brake pressure parameters. As a major benefit for the railways, with the monitoring of the MR or air brakes no longer a prime impediment for isolated idling locomotives, the **B**rake-**S**ense will reduce engine starts and extend shutdown times dramatically and especially for locomotives coupled to trains or with leaking main reservoirs, drain valves, etc.

Brake-**S**ense can be applied as option to the **ST**op-**I**dle Technology System or any AESS equipped locomotive.

Hand brake force control using shackle and ADL280RFID

Features

- Compact and robust design (IP67)
- Measurement range 0…50 kN (0…11,200 lbf)
- integrated sensor electronics with 3 interfaces (analog output signal 4 - 20mA, digital interface CAN, radio transmission range up to 20m to ADL 280 RFID V2)



This screenshot shows the Hand Brake Status

Options

- Handheld instrument with direct force display
- Switching amplifier
- Customized dimensions and nominal forces
- Mobile indicator for strain gauge sensors with A.S.T.-RFID-Transponder

Reference

More than 4,000 locomotives with **ST**op-**I**dle Technology System are worldwide in duty, e.g.:

+ BR 202, 203, 204, 212
+ BR 216, 217, 218, 225
+ BR 219, 229
+ BR 344-347
+ BR 232, 233, 234
+ BR 241, 242
+ BR 290, 291, 294, 295, 298
+ SVT 675, BR 708, 714, VT 618, 619
+ 2TE116
+ GP9, GP10, GP22-ECO, GP20C, GP38
+ RS1325, SW1001, MP15AC
+ SD18, SD30C, SD40
+ AC4400

...

AST Gruppe
Angewandte System Technik

Stop Idling ... Stop Global Warming
Reduce Maintenance ... Reduce Noise

Idle Free

The ASTop-Idle

Fuel Operated Heating Systems for Diesel Engines

Idling of locomotives is no longer an option. Let us show how your road can achieve your goal of reducing GHG, noise and maintenance all year round with our self-powered Idling Stop Technology.

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