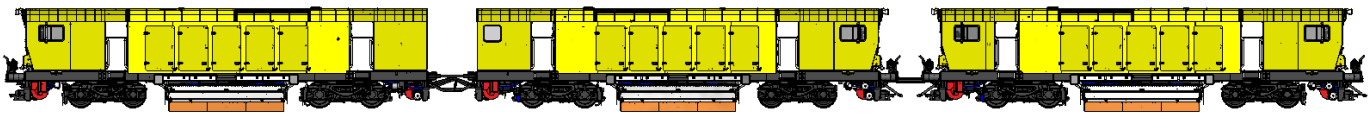
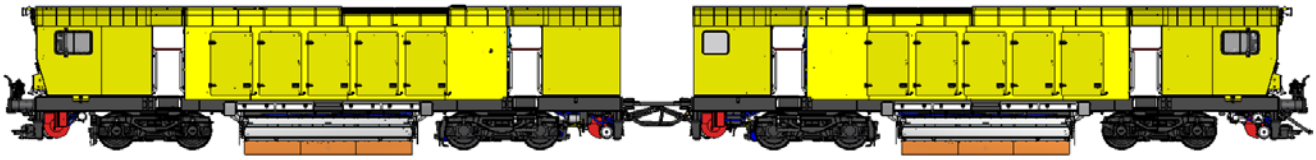
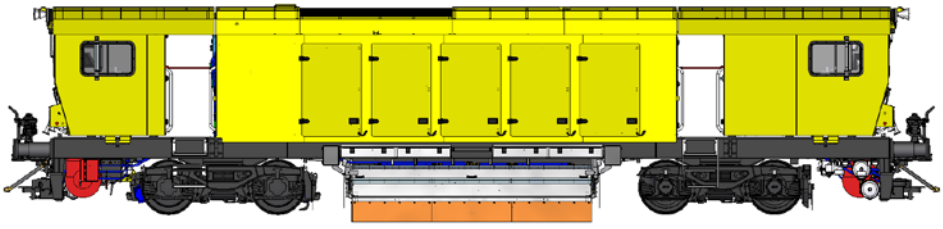
RGH30C RAIL GRINDER
GENERAL MACHINE DESCRIPTION



RGH30C2 Rail Grinder – 30-stone Machine Configuration



RGH20C2 Rail Grinder – 20-stone Machine Configuration



RGH10C2 Rail Grinder – 10-stone Machine Configuration

1. SCOPE

1.1. The 30-stone rail grinding machine is a 20-stone RGH20C2 rail grinder coupled to a 10-stone RGH10C2 rail grinder. The two machines can be operated independently or coupled together. This equipment is designed to remove corrugations and other surface defects, and to re-profile the rail head on both rails in track switches, crossings, and plain line conventional railroad track set at 1,435 mm gauge.

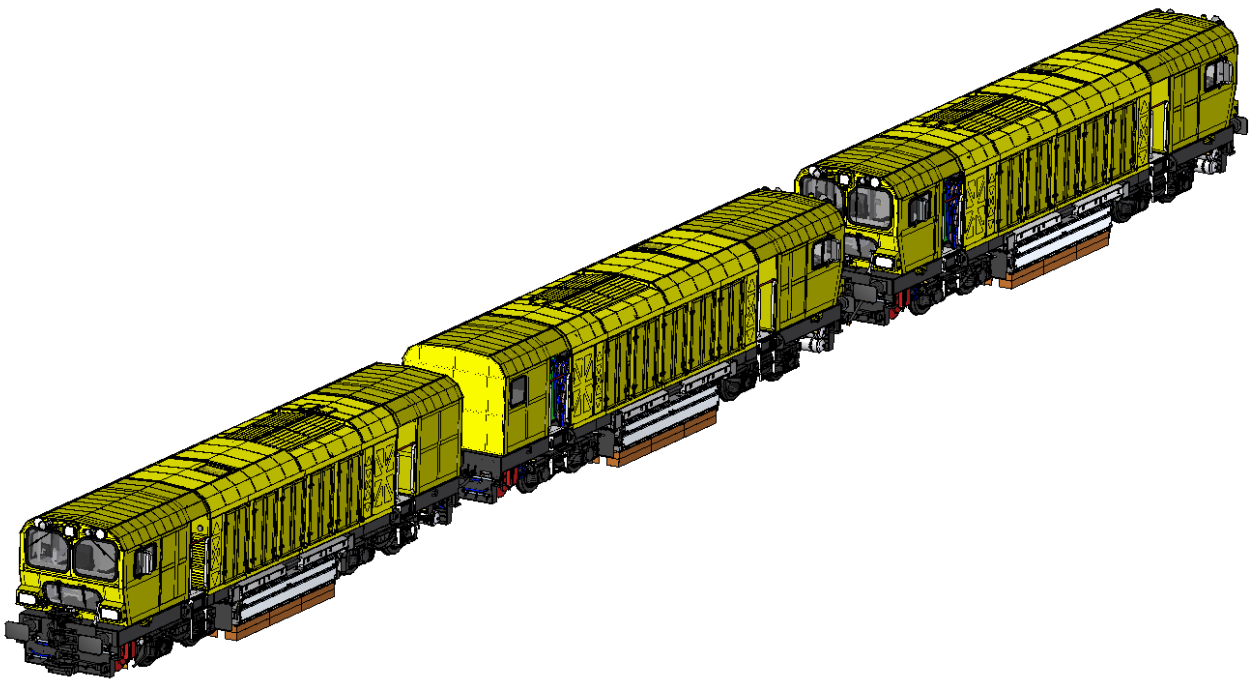
- The machine is designed to comply with EN 14033, the comprehensive European railway equipment standard, and local ATM requirements.

- Each of the three grinding cars is fully functional with its own engine, grinding carriage, hydraulic system, and controls. The cars are oriented so that either coupled or separated, there is an operator cabin at each end. In either configuration, the entire consist is controlled by a single operator from either of the end cabins, but by only one at a time dependent upon which cab is in control.

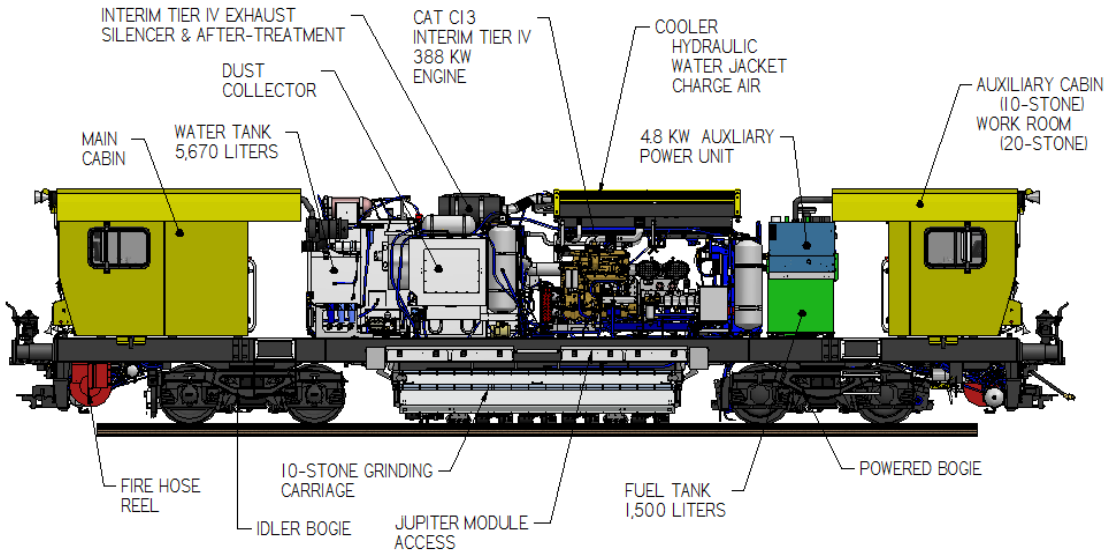
- The machine is CE marked.

1.1. Below is an isometric model view of the 10-stone grinding machine. This car can operate independently of the 20-stone machine and has a cabin on both ends of the car, as well as hooks and buffers, and Scharfenberg and Faiveley coupling capacity on both ends of the machine. The 10-stone machine also has profile and corrugation measurement systems on board.

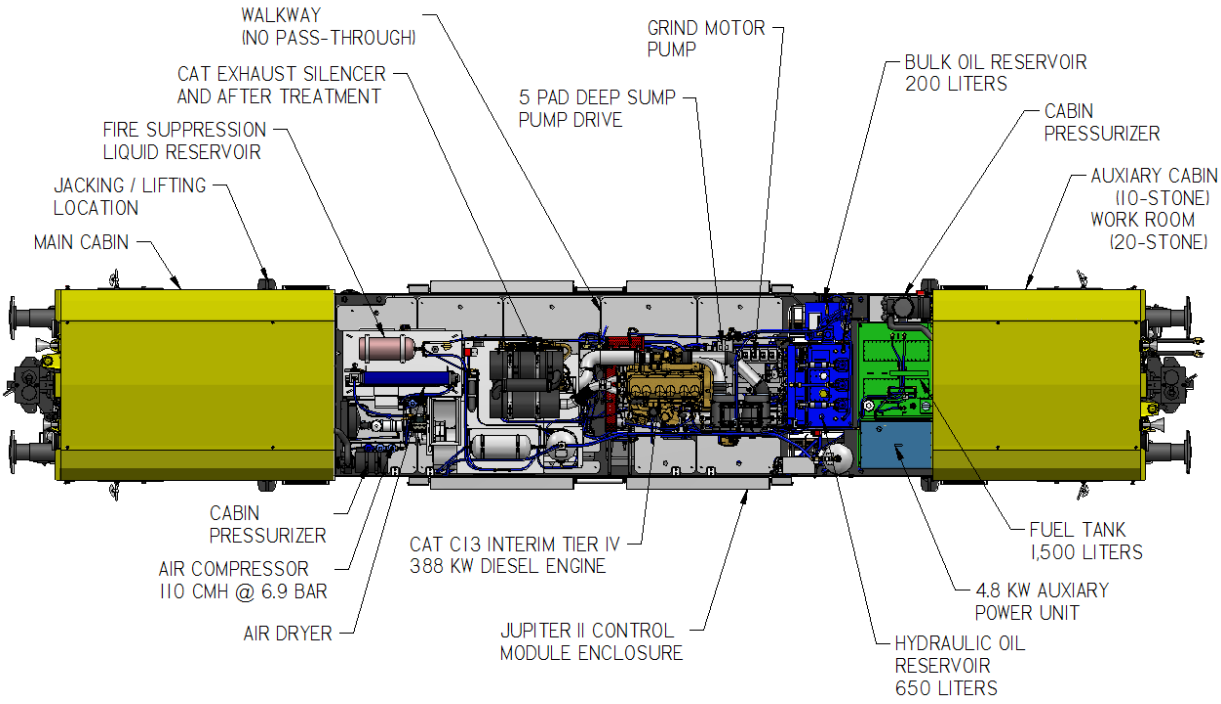
1.2. Below is an isometric model view of the 30-stone grinding machine. This grinding train consists of a 20-stone two car machine (left most two cars) connected to a 10-stone machine (right most car). The 20-stone machine has one cabin per car, and is configured such that the cabins are on the outer ends of the connected machine. One primary difference between the 20-stone machine and the 10-stone machine is that the 10-stone machine has two cabins per car, whereas the 20-stone machine has one cabin and a work room per car, instead of a second cabin. The 20-stone machine cannot be operated as two stand alone 10-stone machines. The cabin ends of the 20-stone machine are configured with hooks and buffers, and Scharfenberg and Faiveley coupling capacity. The 10-stone machine also has profile and corrugation measurement systems on board. All three cars are designed to be compliant with clearance requirments for ATM lines 1, 2, 3, and 5, and are equipped with a Scharfenberg coupling configuration for emergnecy towing on lines 1, 2, and 3 and Faiveley coupling configuration for emergency towing on line 5.



1.3. General machine configuration and layout.



Side view



Top View

1.4. In simplified form – the typical grinding operation includes the following activities;

- Evaluation of existing rail condition
  - Rail defects
  - Unacceptable profile
  - Corrugation
  - Removal of mill scale (new rai)
- Decision on what needs to be done to correct existing problems or potential problems
  - Patterns to run
  - Pattern sequence
  - Number of passes required
  - Stone selection
  - Speed
- Evaluation of the completed grind and confirmation results are desired
  - Profile measurement and reporting
  - Corrugation measurement and reporting

2. MAIN TECHNICAL DATA

Reference the following Document Plan Information Sets;

- ***Overall Assembly 10-Stone Machine***
- ***Overall Assembly 20-Stone Machine***
- ***Overall Assembly 30-Stone Machine***
- ***Weight Analysis***
- ***Clearance Gauge Verification 10-20 Stone Machines***
- ***Paint Specification***

2.1. Overall length (approximate);

10-stone: 15,172 mm (between buffer faces)

20-stone: 31,229 mm (between buffer faces)

30-stone: 46,736 mm (between buffer faces)

2.2. Machine width (approximate);

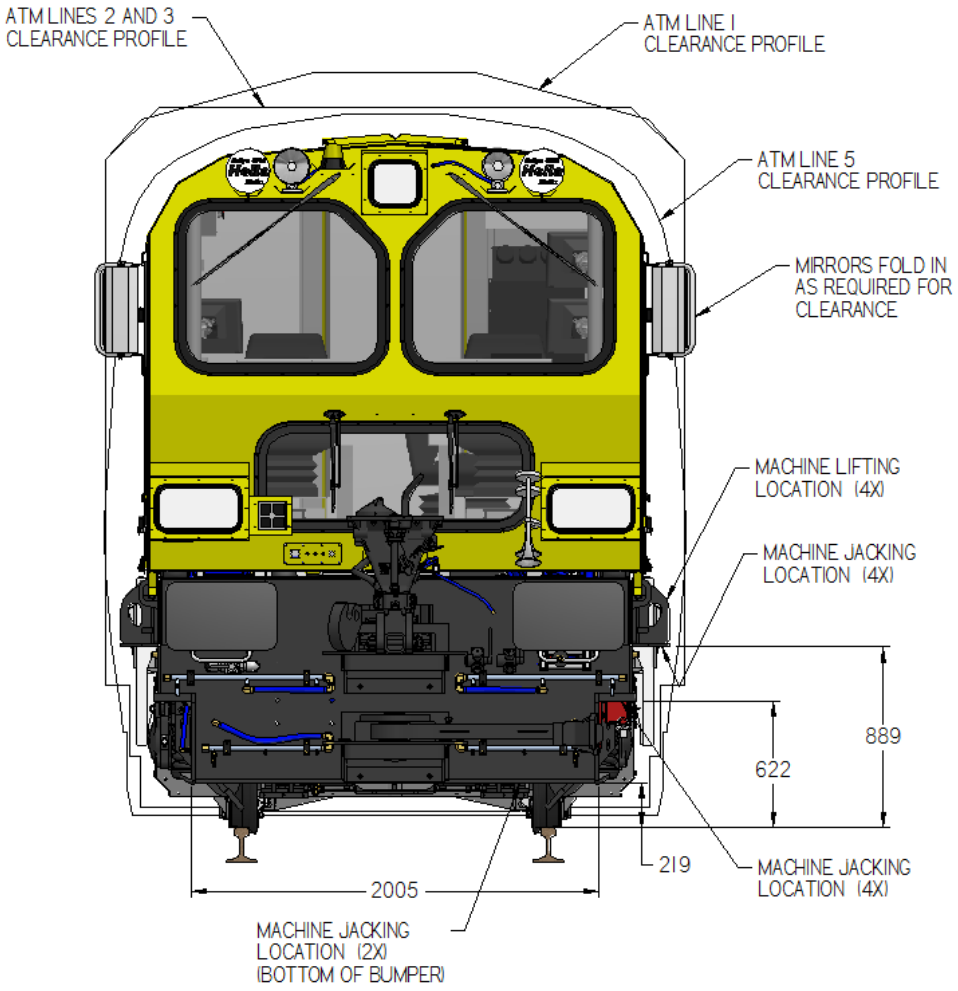
2,450 mm at upper-main enclosure

2,705 mm at main frame

2,970 mm at cab mirrors (adjustable)

2.3. Working height: 3,420 mm (approximate)

2.4. Machine designed to fit within ATM clearance profiles for lines 1, 2, 3, and 5.



2.5. Back to back wheel Gauge: 1,360 ± 3.3 mm

2.6. Wheel Diameter: 840 mm

Wheel profile type UIC ERRI B.1, Combined B to the UIC Specification 510.2 or-4th edition – May 2004 with flange h =28mm and conicity of 1/20

2.7. Wheel Base: 8,230 mm between bogie centers

1,800 mm between axles on each bogie

2.8. Weight: 52,000 kg (per car, wet)

13,800 kg (maximum axle load)

2.9. Maximum travelling speeds

0% grade: 60 km/hr

3% grade: 40 km/hr

5% grade: 15 km/hr

2.10. Minimum traveling curve radius: 50 m

2.11. Maximum traveling gradient: > 5.1% (dry or sanded rail)

2.12. Maximum towing Speed: 100 km/hr

2.13. Minimum braking rate on dry, level track: 1.0 m/s^2

2.14. Maximum super-elevation: 180 mm

3. GRINDING SYSTEM

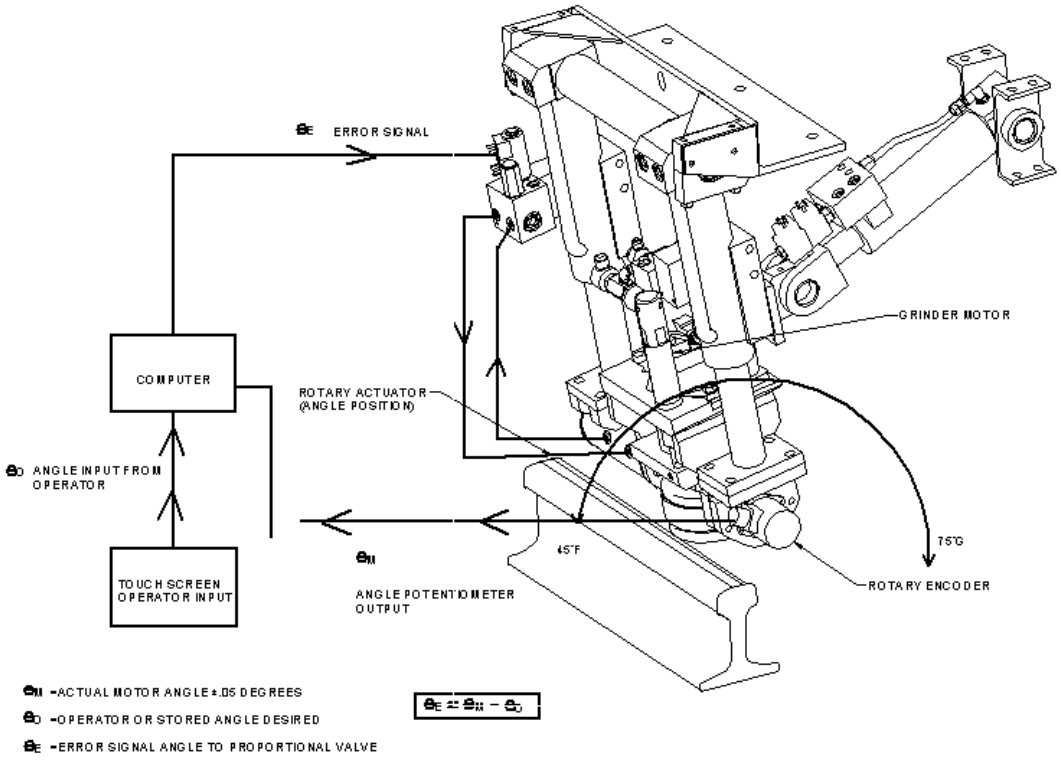
Typical Grinding Carriage

3.1 The grinding carriages are comprised of two halves, each with five grinding heads. When a grinding carriage is stored, the two carriage halves are pulled together. Grinding heads and carriage guide wheels are lifted with hydraulic cylinders and are held in the travel position by a heavy-duty lock arrangement. A system of sensors and visual indicators is provided to alert the operator if any portion of any carriage is not in the raised and locked position. When a carriage is deployed, the two

carriage halves are hydraulically biased apart from each other to keep the flanges of the carriage guide wheels in contact with the rails. The bias force is reduced and the bias system is locked when the grinding carriage is propelled through switches. A system of sensors and visual indicators on the control monitor is provided to tell the operator that the carriages have deployed properly and also to alert the operator in the event of a grinding carriage derailment. If a grinding carriage does not deploy properly, the grinding heads will not go down and an alarm message will be displayed on the monitor. If a carriage derails while grinding, the propel system stops the vehicle, the grinding heads stop spinning, and an alarm message is displayed on the monitor.

3.2 Each C-model grinding head consists of a hydraulic motor, spindle/bearing assembly, and grinding wheel connected together and mounted on a linear slide. A hydraulic cylinder moves the assembly along the slide to feed the grinding wheel into the rail. Each grinding head is mounted on its own supports, and each is controlled independently.

3.3 The angular position, the lateral position, and the target grinding power are all programmed into grinding patterns. A proportional valve is used to control the pressure on each grinding wheel independently through a closed-loop circuit, which monitors the power absorbed by the grinding motor. The target power is adjustable from 0% to 100% of the maximum 17 KW output. The grinding head angle is adjusted with another proportional valve and a hydraulic rotary actuator. A rotary transducer on the main pivot is used for grinding head angle feedback. The allowable angle range is 75° gauge to 45° field measured from vertical. The lateral position of the grinding head is controlled with a third proportional valve and a hydraulic cylinder. It is adjusted using feedback from a linear transducer mounted inside the cylinder.



Grinding Head Control Scheme

3.4 Minimum curve for deployment: 350 m

3.5 Grinding direction: both forward and rearward

3.6 Grinding speed: 2 –16 km/hr, typically 3-10 km/hr

3.7 Minimum grinding curve radius: 70 m

3.8 Carriage wheel base: 2,260 mm

3.9 Carriage guide wheel diameter: 127 mm

3.10 Grinding heads are each controlled and operated independently

3.11 Grinding wheel diameter: Typically, up to 152 mm (If required, individual heads can be configured for 280 mm grinding wheels for slot grinding)

3.12 Grinding wheel thickness: Typically, up to 80 mm (280 mm heads: up to 30 mm)

3.13 Grinding motor speed; Typically, 5,800 RPM (nominal) (280 mm heads: 3,600 RPM)

3.14 Grinding motor power: adjustable to 16 KW (100%)

3.15 Grinding head angle range: 75° Gauge to 45° Field

3.16 Head angle accuracy: ± 0.5°

3.17 Lateral shift position resolution: 1 mm

3.18 Rail surface roughness after grinding: Typically, 10 microns or less (influenced by grinding wheel selection, grinding pattern selection, and grinding speed)

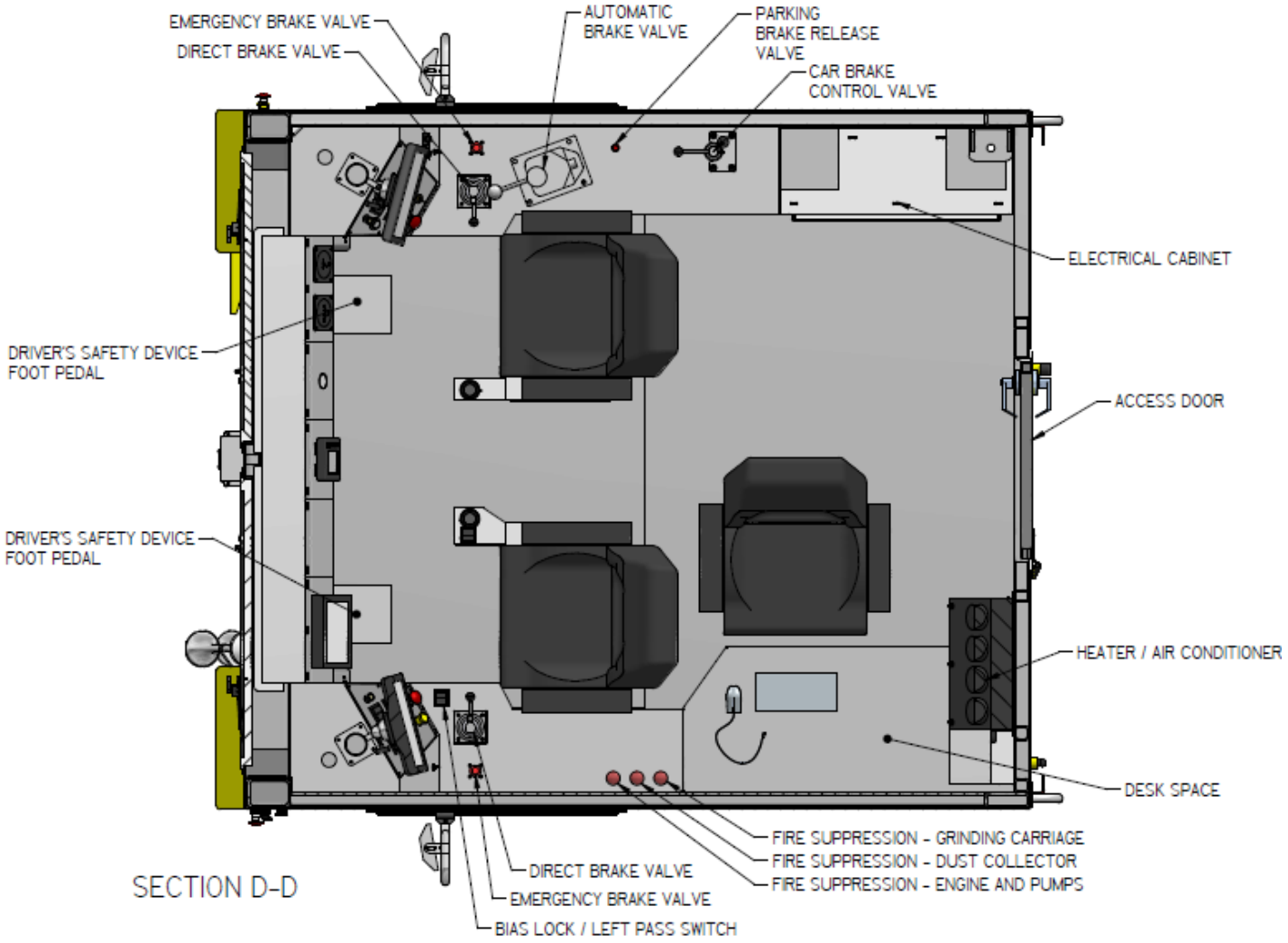
3.19 Fire resistant protective shields are provided to contain sparks, dust, and in the event of a failure, broken grinding wheels and debris.

4. CABINS

Reference the following Document Plan Information Sets;

- ***Main Cab Detail***
- ***Auxiliary Cab Detail***
- ***Driver Visibility***

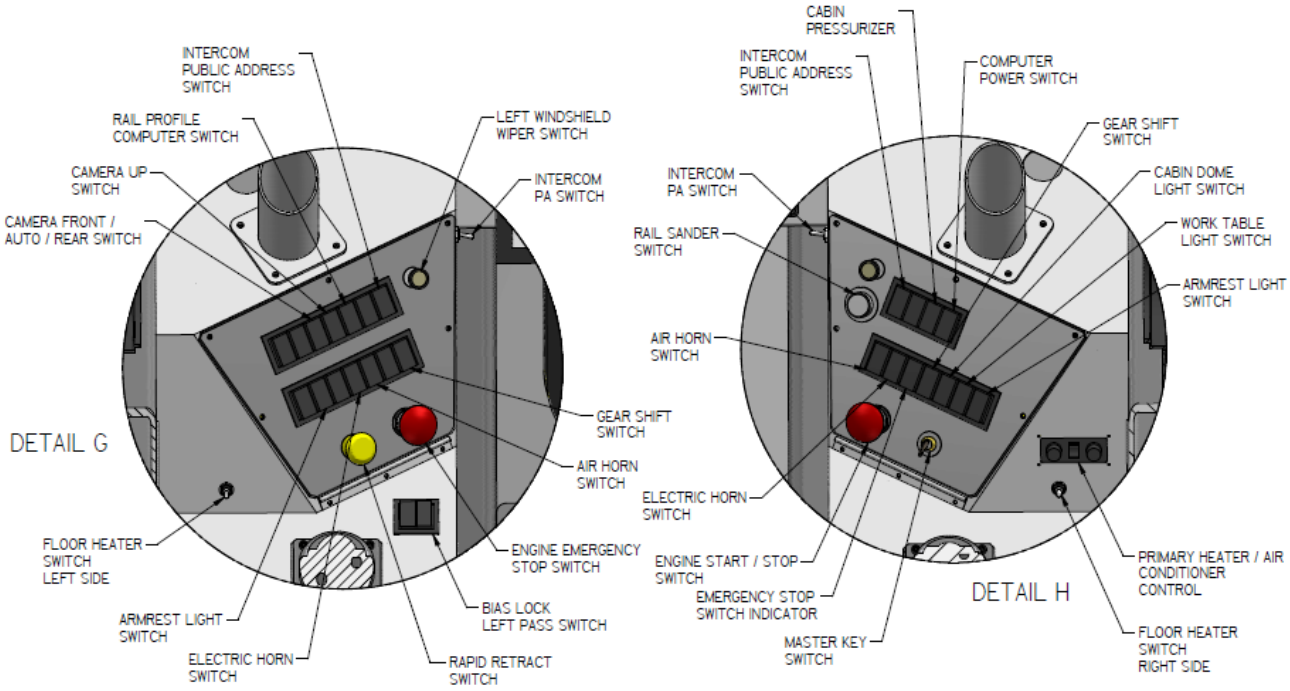
4.1. Each cab seats one driver and one operator. The two can be one and the same, but in that case, the individual moves from one seat to the other as the machine transitions between work mode and travel mode. Each cab is equipped with ergonomically designed control layouts containing the applicable controls for grinding operation, traveling, communicating, the fire suppression system, and other machine functions.



Overhead View of Main Cabin Layout

Main Operator's Console

Main Driver's Console



Main Operator's Console **Main Driver's Console**

4.2. Cabs are pressurized and equipped with air conditioner/heaters.

4.3. Cabs are insulated and mounted on vibration isolators to minimize noise and vibration.

4.4. All cabs are accessed through a door in the back which opens to a well lit, covered area. From this breezeway, ladders are provided on both sides of the machine, and on the main cabs another door opens to the walkway through the engine enclosure. The auxiliary cab on the 10-stone car is equipped with the same access to the breezeway and steps on the side of the machine, but has no access to the main enclosure. There is access to the fuel tank, the AC genset, and fire suppression bottles on the breezeway between adjacent to the auxiliary cab.

4.5. Windscreens are equipped with windshield wipers, washers, and defrosting equipment.

4.6. Side windows can be opened slide-style.

4.7. Handrails, ladders, fall protection, and anti-slip tread plates are provided to allow safe access to the cabins, walkways, and service points

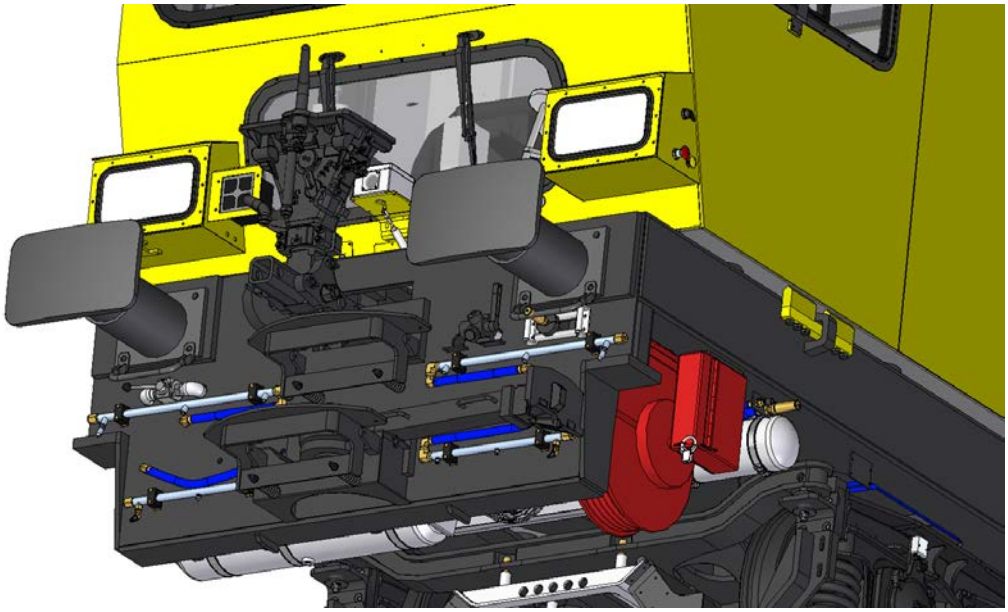
5. FRAME & COUPLINGS

Reference the following Document Plan Information Sets;

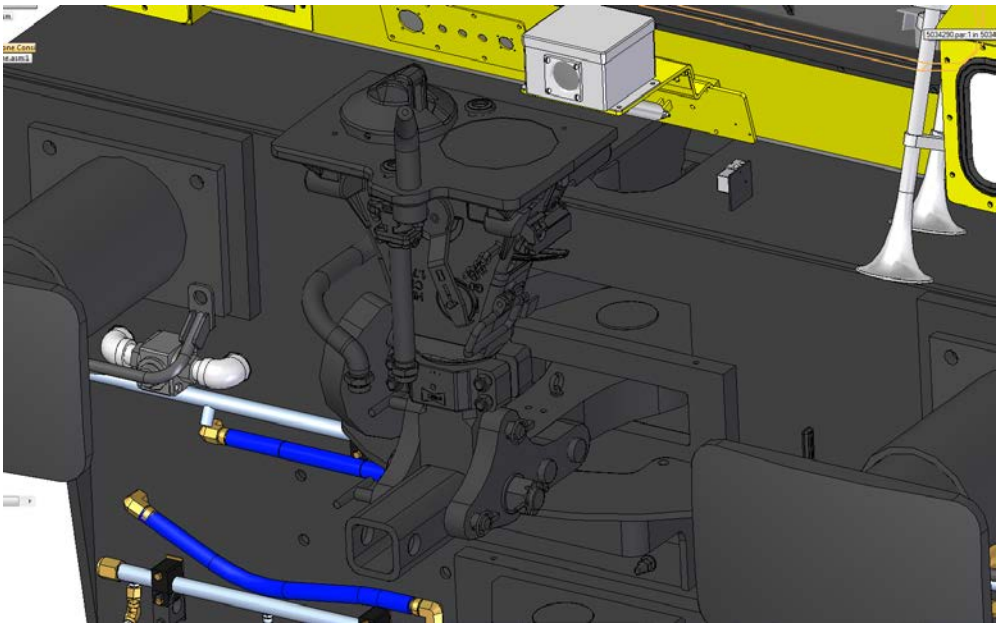
- ***Main Frame Stress Analysis***
- ***Main Frame Assembly***
- ***Lifting Points and Ferry Boat Fastening***
- ***Coupling Study – 60m-115m Reverse Curve***
- ***Coupling Study – 70m Curve***
- ***Coupling Study – 70m Reverse Curve***
- ***Coupling Study – 120m Reverse Curve***
- ***Coupling Study – Configurations***
- ***Coupling Study – Vertical Movement***

5.1. The machine frame is entirely of welded steel construction involving structural steel sections and plates and built to withstand a 100 tonnes compressive load applied at the couplers.

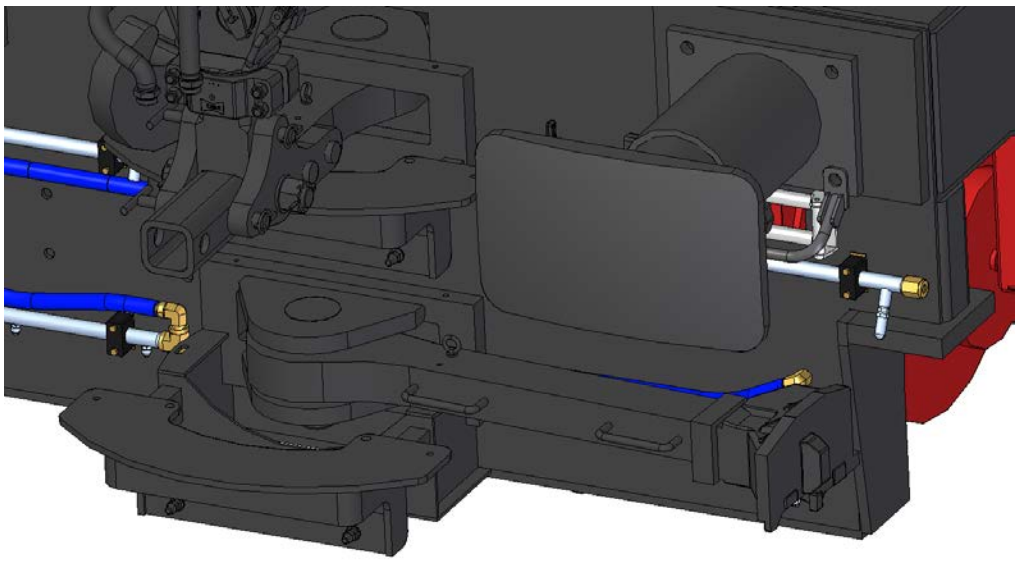
5.2. The coupling gear is ATM Milan standard transit emergency tow couplers and hooks and buffers. Emergency towing is accomplished by coupling through a Scharfenberg coupler head for lines 1, 2, and 3, and through a Faiveley coupler adapter for line 5. The images below show the coupling gear arrangement on the end of the machine.



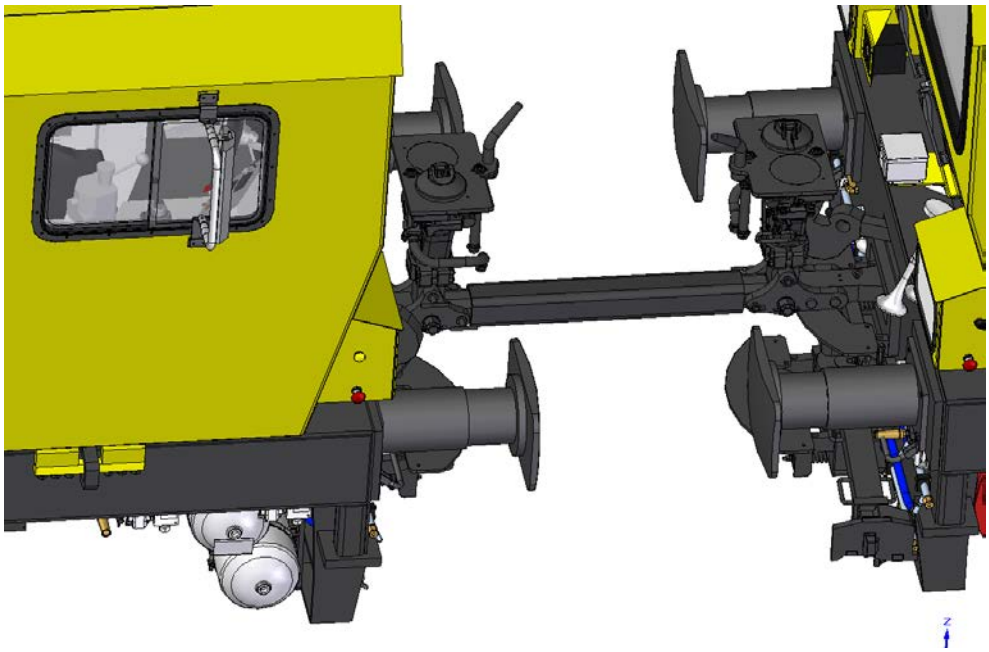
5.3. Emergency towing for lines 1, 2, and 3 can be achieved by connecting to the Scharfenberg coupler head. The Scharfenberg coupler head is pinned vertically for work mode and then swung and pinned to the side to improve forward vision. If the machine needs to be towed, the pin holding the head to the side is removed and the pins holding the head vertical are removed to allow the head to swing down, and then re-pined in the horizontal position. In the image shown below, the Scharfenberg coupling head is shown pinned vertically and swung forward.



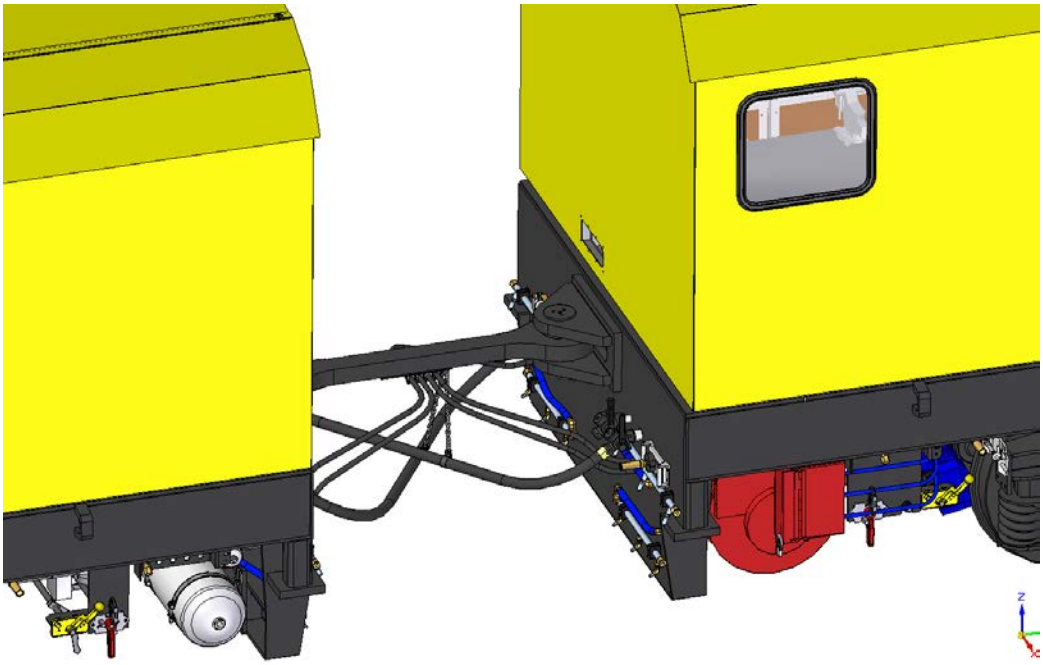
5.4. Emergency towing for line 5 can be achieved by connecting to the Faiveley coupler head adapter. The Faiveley adapter head is pinned to the lower bumper assembly. A spring adjusted support assists with supporting the assembly when coupling unit is swung out for towing. The coupling is swung to the side and pinned in a position against the bumper plate of the frame for normal working situations (as shown).



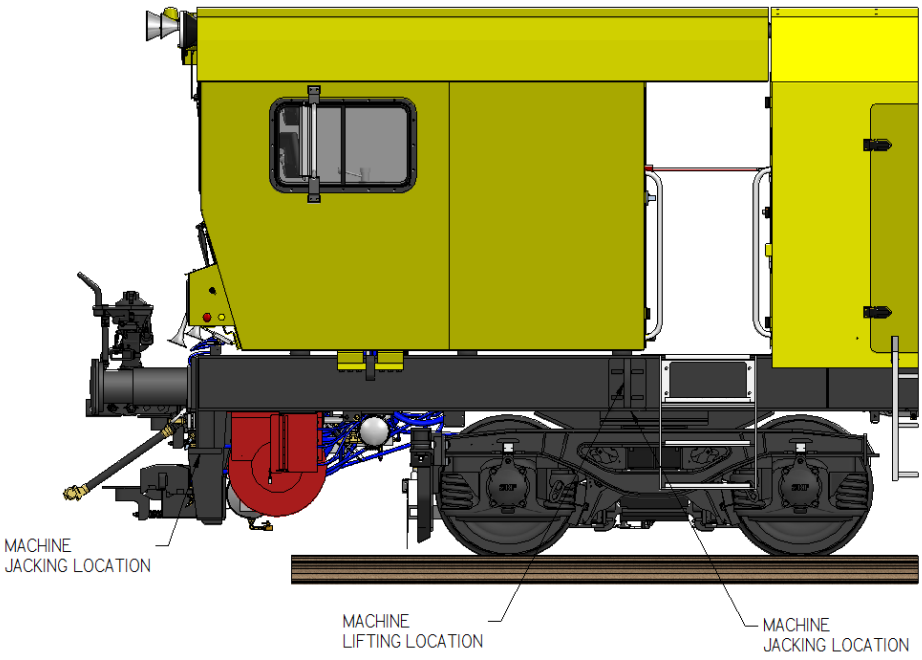
20-Stone Grinder connection to the 10-Stone Grinder is done with a rigid beam linked into the base of the Scharfenberg coupler when the Scharfenberg coupler is swung into the upward position



The 20-Stone Grinder car 1 to car 2 connection is achieved with a rigid link with spherical bearings on each end of the tow bar.



5.5. Jacking pads are supplied on each corner of the frame. Lifting points are also designed as an integral part of the machine frame.

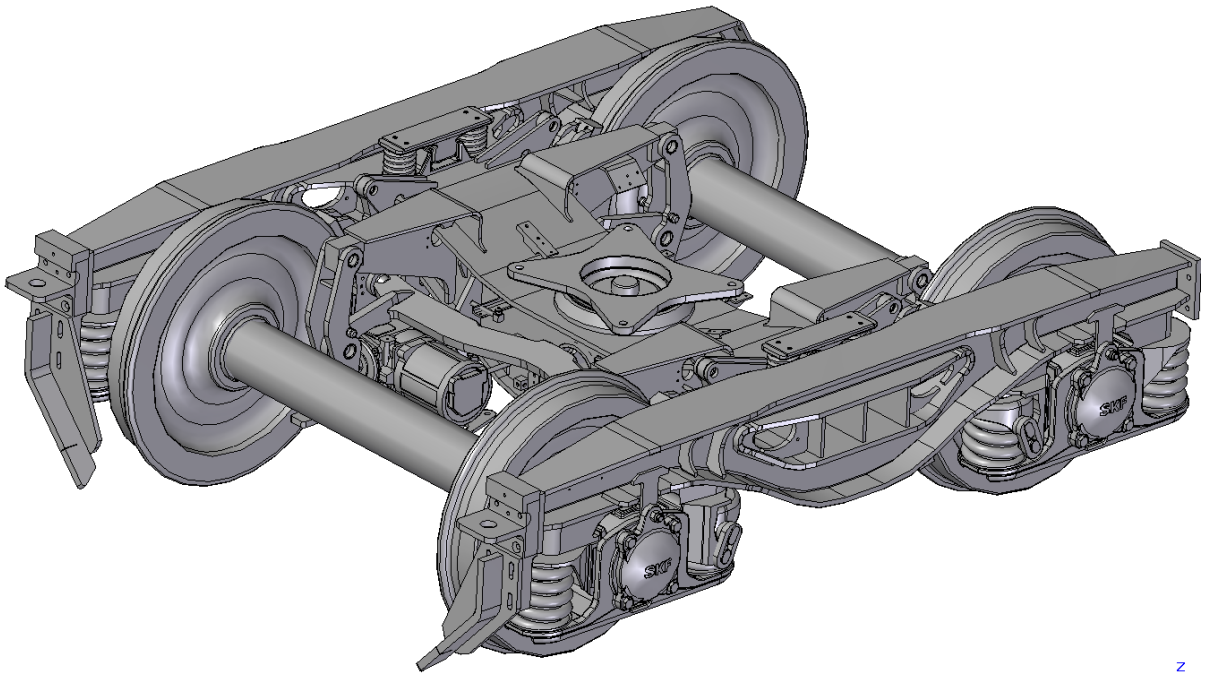


6. RUNNING GEAR

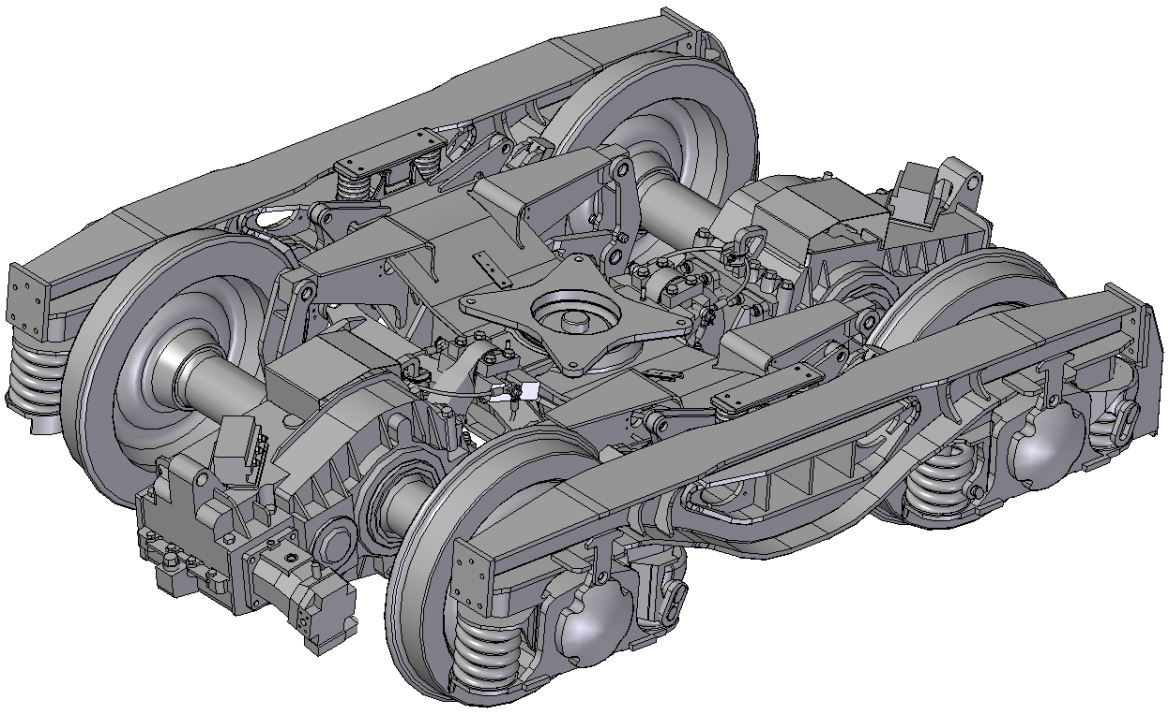
Reference the following Document Plan Information Sets;

- ***Bogie Mounting***
- ***Check of Bogie – Frame Interference***

6.1. Running gear consists of two Y-27 type compliant bogies on each car. The bogie suspension is composed of friction damped stacked coil springs. Side bearing resistance is also achieved using properly sized coil springs. The bogie suspension set has been dynamically tested and NOBO - approved.



Front bogie – Y-27 type with non-powered axles and life guards.



Rear bogie – Y27 type powered axles with two-speed gear boxes.

6.2. The rear bogie (engine end) of each car has two powered axles. The front bogies are non-powered.

6.3. The powered axles are driven hydraulically through heavy duty gearboxes, which are shifted by air. Switches provide verification that the gearboxes are engaged. Neutral switches are also included.

6.4. The bogie suspension is composed of friction damped stacked coil springs.

6.5. Propel motors are variable displacement, piston type motors and part of a closed loop hydrostatic system. The motors are held at the maximum displacement position in work mode. Pressure transducers in the propel systems provide feedback to the computer for operator display and for use in optimizing load sharing between the cars.

6.6. Sanders are provided on the powered bogies.

7. BRAKES

7.1. The brake system consists of rail type circuits for service brakes, spring operated parking brakes, and emergency brakes

7.2. The direct braking system is typically utilized during normal working conditions. Hydrostatic dynamic braking can also be used to assist with speed control when working.

7.3. The brakes can be connected in an auto brake arrangement allowing brake control when connected by a towing vehicle in two different forms;

- A primary arrangement working at a nominal pressure of 7 bar.
- A general system working a pressure of 5.5 bar.

7.4. The brake system circuit allows for control from the cab of the towing vehicle which also supplies the pneumatic pressure – the train braking is then accomplished by brake pipe pressure reduction.

7.5. The brake system can achieve a braking rate of 1 m/sec^2.

7.6. The brakes are designed to hold the cars while at full load at grades of up to 5.1 percent.

7.7. A “Deadman” safety control arrangement is designed into the emergency brake circuit that will automatically apply the emergency brake if the system is not routinely activated at the appropriate time intervals.

7.8. Control valves that are activated by depressing red colored mushroom shaped buttons are located in each cab.

8. ENGINE

Reference the following Document Plan Information Sets;

- ***Power Pack General Assembly***
- ***Power Pack Characteristics and Performance Data***
- ***Engine Intake and Exhaust System General Arrangement***
- ***Fuel System Layout***
- ***Cooling System Layout***
- ***Cooling System Scheme***

8.1. Each 10-stone grinding car is equipped with a 6-cylinder, liquid cooled, electronically controlled, C13 Caterpillar diesel engine rated at 388 kW.

8.2. Engine operating speed is 1,800 RPM.

8.3. The engine control systems are designed to automatically shut down the engines in case of:

- High engine coolant temperature
- High compressor coolant temperature
- Low engine oil pressure
- Low coolant level
- Low hydraulic oil level
- Engine over speed
- Fire suppression system activation

8.4. Engines can also be shut down manually through emergency stop switches inside both cabins and outside at opposite corners of the vehicle.

8.5. Heaters and ether injection systems are included to aid in cold weather starting

8.6. Engine and associated exhaust after treatment is certified to meet or exceed the requirements of the EPA Interim Tier IV / EU Stage IIIB exhaust emissions standards.

NO_x – 2.0 g/kw-hr
NMHC – 0.19 g/kw-hr
PM – 0.02 g/kw-hr

8.7. Cooling systems are designed for use in ambient temperatures of up to 60° C.

- Engine radiator / charge air cooler is equipped with a variable speed fan to provide adequate cooling air flow while minimizing noise.

- Hydraulic oil cooler assembly is mounted beside the radiator / charge air cooler and uses a second dedicated, variable speed fan.

9. FUEL SYSTEM

Reference the following Document Plan Information Set;

- ***Fuel System Layout***

9.1. Each 10-stone grinding car is equipped with a stainless steel fuel tank.

9.2. Fuel tank capacity is 5,670 liters at 90% full.

9.3. Drain ports are supplied in fuel tank sumps.

9.4. Fuel level in all tanks is shown on the control monitors in the cabins.

9.5. Fuel supply flows through high efficiency water separators and fuel filters before entering the engines.

10. HYDRAULIC SYSTEM

Reference the following Document Plan Information Sets;

- ***Hydraulic System Schematic – Car 1 and Car 2***
- ***Hydraulic System Schematic – Car 3***
- ***Hydrostatic Transmission System – Car 1 and Car 2***
- ***Hydrostatic Transmission System – Car 3***
- ***Hydraulic System Layout – Car 1 and Car 2***
- ***Hydraulic System Layout – Car 3***

10.1. JIC 37 degree flare, SAE O-ring boss, and SAE split flange connections are used in the hydraulic and pneumatic systems.

10.2. Hydraulic fluid is Eco-Safe FR-46, a biodegradable and fire-resistant fluid produced by ACT (American Chemical Technologies).

10.3. All hydraulic hose assemblies are compatible Aeroquip AQP hose material with crimped end fittings.

10.4. Hydraulic reservoir capacity is 650 liters

10.5. A manual reservoir fill pump is provided.

10.6. Quick couplers are provided for remote filling or remote filtering of the oil in the hydraulic reservoir.

10.7. Ground level remote drains are provided for all fluids.

10.8. Main suction lines are equipped with magnetic probes designed to capture metallic particles.

10.9. Oil filters are designed to maintain oil cleanliness at a minimum level of ISO 17/14.

10.10. All critical filters are equipped with filter service indicators to alert the operator if they become clogged, and can be changed without draining the reservoir.

10.11. Provision is made for convenient measurement of all circuit pressures.

10.12. Both DC electric and hand-operated emergency pumps are included on each car to provide a means of storing the grinding carriages in the event of a main system failure.

11. WATER SYSTEM

11.1. Each grinding car is equipped with a water tank, low pressure water pump, high pressure water pump, low pressure track spray nozzles, high pressure track spray nozzles, high pressure hand wand, and fire hose.

- The stainless steel water tank capacity is 1,500 liters on each car. The water tank levels are viewed on the control monitor in both cabs, and the operator is alerted when water level gets low (approximately 500 liters) and again when it is empty.

- AC powered heaters are supplied to prevent freezing when the machine is shut down.

11.2. The low pressure water pump is a hydraulically driven, centrifugal style pump suitable for moving large volumes of water and tolerant of contamination.

11.3. Water valves are pneumatically operated ball style, also designed to maximize tolerance to contamination.

- Low pressure track spray nozzles are located on the cab end of each car, and also on the auxiliary cab end of the 10-stone machine. They produce a flat fan pattern and are arranged in line to provide good track coverage. The front and rear nozzles are controlled independently. To conserve water, the spray nozzles operate only when the machine is in motion.

- The high pressure track spray nozzles are located on the cab end of each car, and also on the auxiliary cab end of the 10-stone machine. These nozzles also produce a flat fan pattern.

The nozzles are positioned and tilted for maximum track cleaning benefit when travelling in the direction that their car faces. When travelling in the opposite direction, the high pressure track spray nozzles on the opposite end are automatically actuated.

- Adjustable ditch spray nozzles are mounted at the front corners of the machine and are used to wet combustible materials along with right of way.

- A fire hose reel with 15m hose is located on the cab end of each car. The switches are located outside next to their respective fire hose reels. The fire hose operates any time that the switch is turned on regardless of whether the machine is moving or not.

- In "cold weather mode," the low pressure nozzles are purged with air each time a function is turned off and also if the function is left on and the vehicle sits still for more than one minute.

12. PNEUMATIC SYSTEM

Reference the following Document Plan Information Sets;

- ***Pneumatic System Layout***
- ***Pneumatic System Diagram***

12.1. The pneumatic system on each car includes a 110 m^3/hr hydraulically-driven, screw type air compressor, air filters, air dryer, reservoirs, locomotive air horns, and appropriate brake system components.

12.2. Pneumatic system also supplies air for the dust collector filter purge system.

12.3. Neighboring cars are designed to share the requirements for compressed air.

13. DUST COLLECTOR

13.1. Each grinding car is equipped with an integral dust collector unit, which uses a squirrel cage fan to draw air through a set of high-efficiency, cartridge-type, fire-resistant air filters.

- One pair of filters is purged every 10 seconds in a revolving pattern so that every 40 seconds each filter receives a momentary pulse of air in the direction opposite to normal flow to

dislodge the dust from the filter media. The dust falls down into a storage area, which can be emptied via screw conveyor. After grinding, a 15-minute clean up cycle can be started manually. The clean up cycle allows the purge system to operate while the main fan is not running. The clean up cycle can be interrupted at any time.

13.2. A temperature sensor inside the dust collector housing alerts the operator if the temperature gets above 107° C.

14. FIRE SUPPRESSION SYSTEMS

Reference the following Document Plan Information Sets;

- ***Fire Fighting System***

14.1. Each cab has a 5kg portable fire extinguisher mounted inside.

14.2. A permanently-mounted Kidde wet chemical fire suppression system is also supplied, which can be used to discharge fire suppressant from five 35 liter canisters through a network of hoses and strategically placed nozzles.

14.3. There are ten nozzles in the engine compartment, eight in the dust collector, and ten on each side of the grinding head area

14.4. The system can be hand activated from within the machine cabs, or from opposing exterior corners of the machine frame – activation control is independent for all three regions. The system for each car is independent from the other cars.

14.5. A “fire wire” heat sensor is installed in the engine room on each grinding car and used to set off an audible and visual fire alarm in the event of a fire or excessive heat.

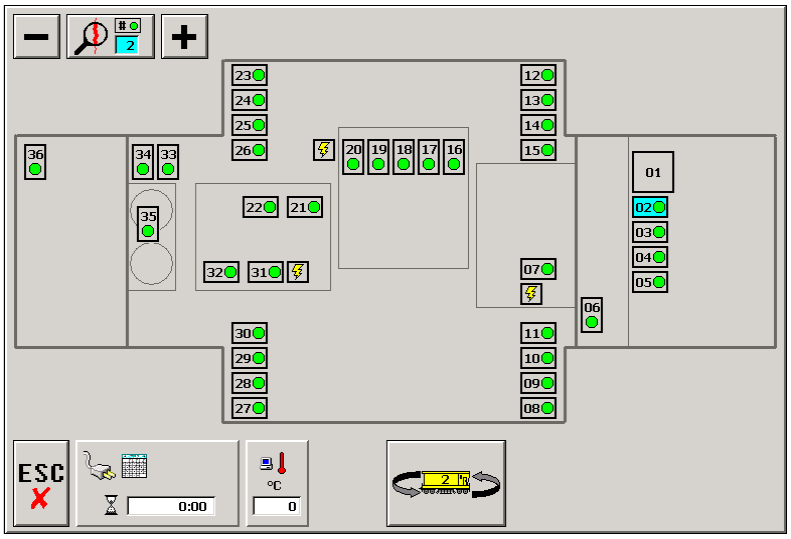
15. CONTROL SYSTEM

15.1. The cabs are equipped with all the necessary controls and instruments required for grinding, traveling, and communicating.

- Traveling controls include a speedometer, tachometer, controls for propelling, braking, lighting switches, horns, and other instruments and gauges required for track traveling. With the

exception of those for the brake system, the gauges are in electronic form and shown on the computer monitor. Gauges for oil pressure, water temperature, and system voltage are shown in histograph format. The histographs show history for the past hour.

15.2. The main computer for each 10-stone car is located in the cab and communicates with the various sensors, switches, and valves on the machine through nodes, which are linked together in a network based on the CAN protocol. These CAN modules are sealed against weather and designed to withstand the conditions present on mobile railway equipment including severe vibrations, dust, pressure washing, and temperature extremes. The three computer networks communicate with each other via Ethernet. This proprietary control system is referred to as “Jupiter II”



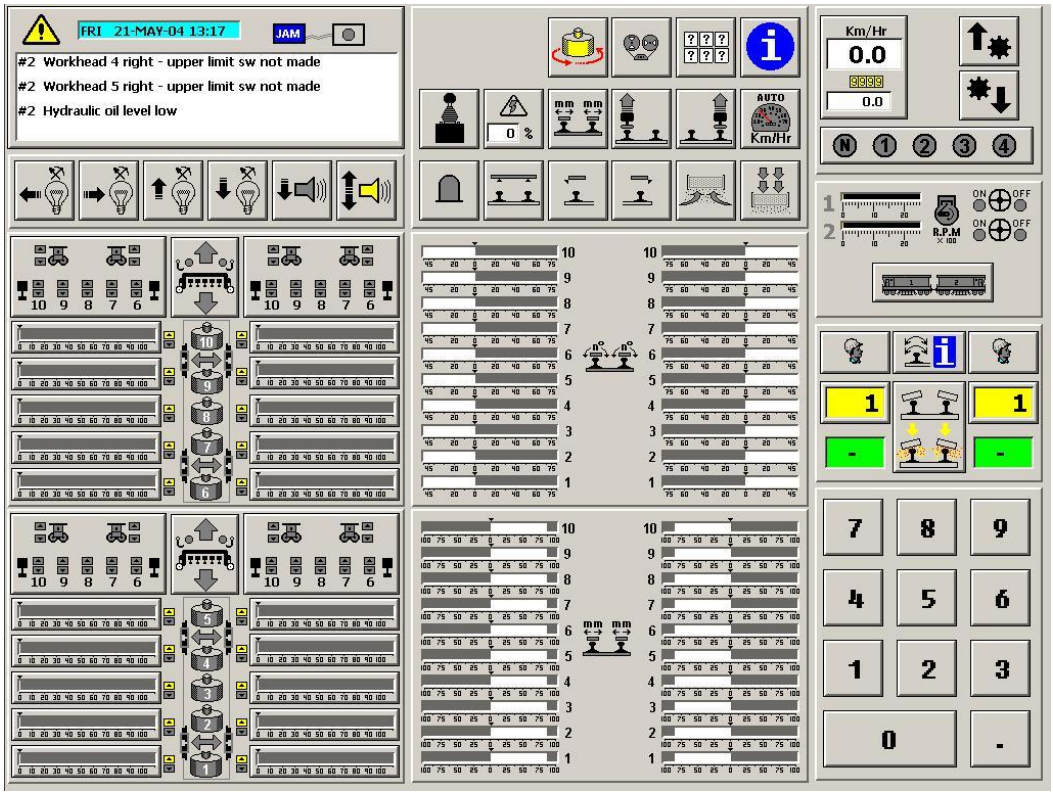
Representative Network Layout

- Each node (CAN module) is responsible for the signals that go to and from the various components that are located in close proximity to that module. The communication between the various components and the nodes is handled through molded cable assemblies with sealed, M12 threaded connectors. All components and cables mounted outside of the cab are sealed with a rating of IP-65 or better.

15.3. All grinding functions are displayed on touch-screen monitors and are controlled by the computer (either manually or automatically) from either of the two cabs.

15.4. Operator controls are in the form of switches, joysticks, and an LCD touch screen. The switches and joysticks are provided for the more repetitive and simple operations. Less frequent and more detailed interactions are handled through the touch screen. The display of information on the touch screen is highly graphical and avoids the use of text and numbers where possible. Design emphasis has been

placed on providing a comprehensive and complete visual presentation of overall train status that requires only the occasional glance during normal operation.



Representative Main Control Screen (20-stone machine)

15.5. All grinding motor movements are computer controlled and can be programmed into grinding patterns. The computer system is capable of storing 99 grinding patterns, which define the angle, lateral position, and power setting independently for each grinding head.

15.6. Once activated, the PASS system automatically sets down each grinding motor in sequence at the same point on the track. At the end of a grinding pass each motor raises again in sequence at the same point on the track. The “smart” PASS allows the machine to remember the locations for the set-downs and pick-ups so that the PASS event switches need not be toggled manually for each pass.

15.7. “Cruise control” utilizes the computer to keep the machine travel speed at a constant pre-set value plus/minus 0.5 km/hr during a given grinding pass.

15.8. Automatic low speed pickup feature retracts all of the grinding heads at the same time should the machine speed drop below the pre-set minimum speed, usually set at 2 km/hr.

15.9. Using both profile and corrugation readings, machine software can recommend patterns and pattern sequence to assist the operator in performing the optimal grind program to achieve the desired final profile free of corrugation.

16. VIDEO CAMERA AND MONITOR

16.1. The low-light, high-resolution CCTV system provides a view of the track on both ends of the machine allowing bi-directional operation from either cab. A color LCD monitor is mounted in each cab. The image is automatically switched from one camera to the other when the direction of the machine changes.

17. ELECTRCAL SYSTEM

Reference the following Document Plan Information Sets;

- ***Electrical System Block Diagram – Schematic, Machine n.01***
- ***Electrical System Block Diagram – Schematic, Machine n.02***
- ***Electrical System Test Specifications, Prestart 20-Stone***

17.1. 24 VDC electrical system includes a 300 amp engine-driven alternator and heavy-duty, lead acid batteries on each chassis.

- 24 VDC system provides power for:
  - Engine Starting
  - Running Lights
  - Back Up Alarm
  - Climate Control
  - Computer Systems
  - All other electrical machine controls

17.2. Cabs are equipped with intercoms and public address systems.

17.3. Vehicle lighting is as follows:

Front View of Similar Machine Showing Placement of Lights

- A single white locomotive headlight is provided at the top of each cab, and two headlights are provided at midpoint. When the headlight switch is turned on, the lights on a given end will illuminate when the machine is traveling in that direction. They will turn off when the machine is traveling in the opposite direction. The control scheme for the three headlights on a given end is per local requirements.

- Work Lights – Work lights are provided on the upper corners of each car. They are flood light beams so as to illuminate a wide area of the track and the space between cars.

- Tail lights – Two red lights are provided near midpoint on both ends of the car. When the headlight switch is turned on, the lights on a given end will be turned off when the machine is traveling in that direction. They will illuminate when the machine is traveling in the opposite direction.

- Beacon lights – Yellow rotating beacons are provided on each operator cabin.

- Trouble Lights – Outlets are provided along the side of the machine where a portable cord reel trouble light can be connected.

- Walkway Lights – Fluorescent lights are provided above the walkways in the engine room and behind the cabs.

- Ladder Lights – Suitable lighting is to illuminate the ladders, steps, and entry areas.

- Control Panel Lights – Spotlights mounted to the ceiling of the operator cabs to illuminate the control panels. The main control monitor is well lit and most switches on the control panels are equipped with LEDs that illuminate when the associated function is turned on.

- Cab Lights – Two 300-mm long fluorescent lights are provided inside the operator cabin. These are normally turned off when the machine is in operation at night.

- Cabinet Light – A retractable cord reel light is supplied in the main junction boxes in the operator cabs as well as the main engine junction boxes.

18. NOISE CONTROL

18.1. The machine is designed to minimize the noise level in the cabs and around the machine. The projected sound levels measured are as follows:

- Inside cab during normal operation measured at the drivers station: 80 dB(A) or less.

- Outside in an open area at 7m from the side of the vehicle and 1.6m above T.O.R. with the engine at 4/5 of maximum speed (1440RPM) and grinding systems not operating: 75 dB(A) or less.

19. RAIL MEASUREMENT SYSTEMS

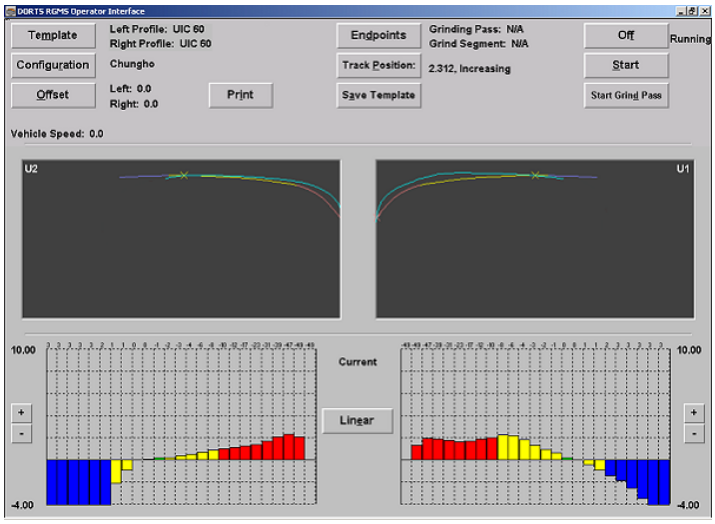
19.1. Rail profile measurement system (cross-sectional)

- Machine-mounted, 2-camera, laser-based RGMS profile measurement systems manufactured by KLD Labs are supplied on Car 1 of the 20-stone machine, and on the 10-stone machine.

- Measurement frequency can be adjusted as needed.

- Data is displayed in real time on a monitor in the respective cab. Data files can be reviewed in the cab or moved to an office computer.

Laser/Camera Enclosure



Operator Interface

19.2. Rail Corrugation measurement (longidutinal)

- Accelerometer-based corrugation measurement systems are supplied on Car 1 of the 20-stone machine, and on the 10-stone machine. This system translates vibration data into a graphical representation of rail surface corrugation.

- In 30-stone mode, one system is positioned at the extreme ends of the machine, enabling efficient before and after measurements.

- Data is displayed in real time on a monitor in the respective cab. Data files can be reviewed in the cab or moved to an office computer.

19.3. Surface roughness measurement.

- A handheld digital Mitutoyo-brand profilometer is supplied to measure rail surface roughness. Measurement data can be viewed through the display on the instrument or transferred to another computer.

20. ACCESSORIES AND SPECIAL TOOLS

20.1. Any accessories and any special tools required for maintenance are supplied.

20.2. Storage space for tools and grinding stones is provided on the machine.

20.3. Hoist points, slings, and shackles are provided for lifting the cars with a crane.

Similar 20-stone Rail Grinder Currently Operating in Germany

Similar rail grinding machines have seen long term service in a variety of countries around the world, including the UK and Germany. The C-model machine is adaptable to a wide range of grinding requirements, environmental conditions, and unique customer needs. Please address any questions or requests for additional information to:

Harsco Track Technologies
2401 Edmund Road, Box 20
Cayce-West Columbia, SC 29171

Tel: 803-822-9160
Fax: 803-822-4817

or

Harsco Track Technologies
415 N. Main Street
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HARSCO RAIL