



TG-8 RAIL GRINDER GENERAL MACHINE DESCRIPTION



SCOPE

This specification covers the design and manufacture of Harsco Rail 8-stone rail grinding machine with dust collection offered as an option. The 8-stone rail grinder consist is made up of a single powered car with an operator cab, hydraulically operated grinding motors, and computer control system. An optional dust collector can be installed on a trailer coupled to the rail grinder unit. The rail grinder is primarily used to grind mainline rail, and it also has the ability to grind through stations, mainline turnouts, and yard rail

1. GENERAL

The standard rail grinder is self-contained, self-propelled with hydraulically operated grinding motors, and includes a chassis of welded steel construction, diesel power plant, brakes, parking brakes, pressurized and air conditioned operator's cab, and computerized controls for grinding functions. The Rail Grinder has the ability to remove rail defects such as corrugations, wheel burns, secondary rail batter, head checking, and rail-flow on the running surface of the head of the rail by re-profiling.

Equipment and components comply with all appropriate clearances, applicable codes, and regulatory agency standards.

2. MAIN TECHNICAL DATA

- 2.1. Overall length (approximate): 8,912 mm (350.9 in)
- 2.2. Machine Width (approximate): 2521.5 mm (99.3 in)
- 2.3. Machine Height (approximate): 3368 mm (132.6 in)
- 2.4. Axle Spacing: 5029mm (198 in)
- 2.5. Weight (approximate): 20,865 kg (46,000 lb)
- 2.6. Maximum traveling speed: 0 to 3% grade - 56 kph (35 mph)
4% grade - 40 kph (25 mph)
- 2.7. Minimum curvature: 50 m (164 feet) radius
- 2.8. Maximum traveling gradient: 6.0 %
- 2.9. Maximum Super-elevation: 150 mm (6 in)
- 2.10. Track gauge: 1,435 mm (56.5 in)
- 2.11. Turnouts: Mainline - Nos. 4 through 20: Yard - Nos. 5 through 20

3. CHASSIS/FRAME

- 3.1. Chassis frame is of welded construction, consisting of longitudinal and lateral beams of appropriate strength to support the loads imposed during operation.
- 3.2. Frame strength is verified by finite element analysis using several load cases.

4. RUNNING GEAR

- 4.1. Axle assemblies are fitted forged steel railroad wheel and inboard wheel bearings to meet tight clearance restraints.

- 4.2. Drive axles are fitted with single speed heavy-duty gearboxes, which are shifted into gear with air pressure. Springs hold the gearboxes in neutral when the air and electrical systems are de-energized.
- 4.3. 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.
- 4.4. The axles, wheels, and wheel bearings are non-insulated.

5. ENGINE

- 5.1. The 8-stone machine is powered by a 6-cylinder, liquid cooled, Tier III(f) electronically controlled Cummins QSL9 diesel engine rated at 261 kW (350 BHP). Engine operating speed is 1800 RPM.

The engine control system is designed to automatically shut down the engine in case of:

- 5.1.1.1. high engine coolant temperature
 - 5.1.1.2. high compressor coolant temperature
 - 5.1.1.3. low engine oil pressure
 - 5.1.1.4. low coolant level
 - 5.1.1.5. low hydraulic oil level
 - 5.1.1.6. engine over speed
 - 5.1.1.7. fire suppression system activation
- 5.2. The engine can also be shut down manually through emergency stop switches inside both cabins and outside at opposite corners of the vehicle.

- 5.3. The engine cooling system is designed to allow operation in ambient temperatures up to 50° C (122°F).
- 5.4. The engine is certified to meet or exceed the requirements of the Tier IV exhaust emissions standard.
- 5.5. Heaters and ether injection systems are available as optional equipment to aid in cold weather starting.

6. FUEL SYSTEMS

- 6.1. The standard diesel fuel reservoir on the TG-8 has a capacity for 10 hours.
- 6.2. Fuel supply flows through a water separator and high efficiency fuel filters before entering the engine.
- 6.3. Fuel level is monitored via an ultrasonic level sensor and shown on the control monitors in the cabins.
- 6.4. A fuel line shut-off mechanism, easily accessible to the operator, is provided so that fuel supply can be shut off at the fuel tank in the event of a leak in any part of the fuel line system.

7. ELECTRICAL SYSTEMS

7.1. AC System

- 7.1.1. The equipment includes a generator supplying 10 kva of 208/120 volt, 3 phase, 60 Hz power for the rail grinder auxiliary systems and other miscellaneous external power requirements. An optional 10 kva, 240 volt single phase, 50 Hz electric power supply is offered for the customer selection.

7.2. DC System

- 7.2.1. The electrical system for the primary power plant is 24 Vdc and also has a 12 Vdc system.
- 7.2.2. The system includes heavy duty batteries, with an alternator capable of supplying ample electrical power required to operate lighting and electrical equipment as needed. The batteries are located in an area that is accessible or mounted on a sliding tray that allows easy access. The electrical systems are protected with a master cut-off switch or circuit breaker. 12 Vdc power for the communication system, radios and public address system is provided in case of engine failure.
- 7.2.3. All electrical circuits are protected with a reset thermal circuit breaker or fuses that have an overload value consistent with the current draw of each circuit.

8. LIGHTS

- 8.1. Lights are provided for night operation including site-to-site travel and rail grinding. The lighting is operated from the dc system and includes, but is not limited to, the following:
 - 8.1.1. Head, tail and running lights located at each end of the rail grinder (24 Vdc).
 - 8.1.2. Rail inspection lights, located on each end of the rail grinder, fully illuminating the track from each end of the equipment to a distance of 30 meters (100 feet).
 - 8.1.3. Cab interior and instrument lights, and lights in all enclosed areas, such as engine and generator compartments, etc. and; Adequate lighting for

inspection and maintenance of grinding carriages and grinding motors, including the inspection and replacement of grinding wheels.

9. PNEUMATIC SYSTEM

- 9.1. A compressed air system is provided on each grinding unit to supply air for hand tool outlets located on each end of the grinder. The air system has a capacity of 17 m³/hr (10 cfm), a reservoir of 75 liters (16.5 Imperial gallons), with maximum pressure of 7 bar (100 psi) for operating miscellaneous air tools. It is powered by an engine driven compressor mounted on the main diesel engine. The brake system contains its own reservoirs and is separated from the auxiliary system by a check valve.
- 9.2. The air systems are installed in accordance with manufacturer's recommended procedures and include all necessary plumbing, fittings, reservoirs and valves, meeting industry standards.

10. BRAKE SYSTEM

- 10.1. The brake system is progressive in force application, and is fail-safe. All wheels are braked. An audible or visual low pressure alarm is furnished. Loss of system pressure will automatically set the parking brakes.
- 10.2. A parking brake system is provided.
- 10.3. A means of releasing all brakes if a failure occurs in the primary brake system is provided.

11. HYDRAULIC SYSTEM

- 11.1. JIC 37 degree flare and SAE O-ring boss connections are used wherever possible in the hydraulic and pneumatic systems.

- 11.2. Hydraulic fluid is American Chemical Technologies, Eco-Safe FR-46, biodegradable, fire-resistant hydraulic oil.
- 11.3. The hydraulic system contains a ten micron filtration system to prevent foreign particles from contaminating sensitive hydraulic control valves and components. A hydraulic oil filtration system is included to filter hydraulic oil prior to being added to the reservoir.
- 11.4. All hydraulic cylinder rods are hardened and chromed.
- 11.5. A hydraulic fluid cooling system is provided to ensure proper fluid operating temperature. System fluid level site gauges and temperature gauges are included. In addition, the fluid level indicator activates an audible alarm at present level. Gauges and reservoir shapes are designed so that the monitoring system will properly function on grades and super-elevations.
- 11.6. Hydraulic tubing of high pressure rating and adequate size with steel fittings is used where appropriate. Where flexibility or motion is required, hydraulic hoses of adequate pressure rating and size are used. Tube and hose support clamps are the rubber coated steel type.
- 11.7. Hydraulic hoses, fittings and components are standard to the industry, and of ample size and pressure rated for intended use.

12. DRIVE SYSTEM

- 12.1. The rail grinder propulsion system is hydrostatic, driving the grinding car axles, and is capable of like speeds, forward and reverse, on mainline tracks and grades.

13. RAIL GRINDING SYSTEM

- 13.1. The rail grinder has the ability to remove rail defects such as corrugations, wheel burns, secondary rail batter, head checking and rail flaw, or any defect created by the transit vehicle wheels on the running surface of the head of the rail, by grinding or re-profiling. The equipment is designed for primary use to grind track including tangent track, curves with up to 150 mm (6") of superelevation and curves with a minimum radius of 50 m (164 feet).
- 13.2. The grinder has 8 grinding stones (four per rail). Quality of grinding and the finished rail is highly dependent on the grinding stone used. Harsco Rail has worked with several grinding stone vendors in developing grinding stones that meet the customer expectations.

- 13.3. The rail grinder is capable of operating in either direction without loss of speed or metal removal capacity or productivity, while grinding both rails simultaneously or either rail independently.
- 13.4. The grinding motors are mounted independent of the vehicle frame. The advantage of this design is to keep the grinding stones from wandering on the rail head due to movement of the frame as the grinder moves along the rail.
- 13.5. All grinding motors are adjustable from the operator's cab, with angular adjustments to any angle between plus 45° to gauge and minus 40° to field from the vertical position. The control system for the grinding motor angle settings is a computerized control system. Angular settings are positive, precise and accurate within plus or minus one-half degree.
- 13.6. Lateral positioning of the grinding motors is independent from the angular adjustments to allow proper positioning of the stone for grinding switches.
- 13.7. All grinding motor movements, vertical, horizontal and angular, during the grinding operation, are computer controlled and programmable for pre-selected rail grinding patterns and passes.
- 13.8. The rail grinding operation is effectively performed at any speed from 1.6 to 12.8 km/h (1 to 8 mph). At 2 km/h (1.25 mph), the equipment has the ability to remove 0.076 mm (0.003") in depth in a single pass in the area of wheel contact with the rail, and 0.152 mm (0.006") in depth on the field or gauge side of the rail. Three passes will be required to cover the full width of the wheel contact band on the rail. The removal rate is based on a maximum rail surface hardness of 400 BHN and using a 16 grit stone. The grinding through turnouts is at a speed that is within the capability of the equipment. The work speeds are computer controlled so as to maintain speed regardless of the track grade, up to 5%. The speed remains constant to within plus or minus 0.8 km/h (0.5 mph). The system is designed to

automatically and immediately raise all grinding wheels off the rails if the grinding speed drops below preset limits.

- 13.9. A detection system is included that automatically raises and lowers individual grinding motors after the operator sets the obstructions on the first pass to provide clearance for obstructions.
- 13.10. The rail grinding motors are designed for severe environmental application and to accommodate grinding wheels having a diameter of 152 mm (6 inches). Grinding wheel speed is 4000 rpm which meets recommended abrasive industry standards for the application. A computerized method to monitor and adjust grinding horsepower is included.
- 13.11. The rail grinder is provided with protective shields and spark suppression devices to adequately contain sparks generated by the grinding operation.
- 13.12. Grinding Speeds - 1.6 to 12.8 kph (1 mph to 8 mph)

14. FIRE PREVENTION SYSTEM

- 14.1. A hand held spray device is provided to extinguish small fires caused by sparks.
- 14.2. There is also a permanently-mounted fire suppression system, which includes a network of nozzles that will discharge dry chemical from two 20 kg (40 lb) canisters.
 - 14.2.1. There are nozzles in the engine compartment and strategically placed on each side of the grinding head area.
 - 14.2.2. Fire suppression system can be operated from inside of either cab or by either of two actuators on opposite corners on the outside of the machine.

- 14.3. A “fire wire” heat sensor is installed in the engine room and used to set off an audible and visual fire alarm if the temperature reaches a preset limit.

15. OPERATOR'S CAB

- 15.1. The machine cab is a single centrally located cab with adequate vision in both directions.
- 15.2. The cab seats one operator and one passenger. It is equipped with all grinding operation controls, traveling controls, communication equipment, and fire suppression system actuators.
- 15.3. Handrails, ladders, and anti-slip tread plates are provided to allow safe access to the cabins and walkways.
- 15.4. Windshields are equipped with windshield wipers and washers.
 - 15.4.1. Standard windshields are 14.3 mm (9/16 inch) thick, non-tinted, FRA type I safety glass. (material and tinting subject to customer requirements)
 - 15.4.2. Standard side windows are 12.7 mm (1/2 inch) thick, 45% tinted, FRA type II safety glass. (material and tinting subject to customer requirements)
- 15.5. Space is provided for the installation of a 12 Vdc radio system with control heads mounted within reach of the operator.
- 15.6. Controls, gauges, computer functions and all monitors required for the rail grinding operation are located in front of and within easy reach of the operator. An option is offered to provide grinding control label language in Spanish as well as English. The cab also includes a heater, lighting adequate for night operation including emergency lighting, and locks for all entry doors.

- 15.7. The cab is insulated to reduce the interior noise level to 85 dBA. The cab is also mounted on sound insulating rubber blocks.
- 15.8. The design of the rail grinder allows the operator an adequate fore and aft view during both travel and rail grinding modes of operations. Video cameras and monitors are included to help the operator avoid track obstacles.

16. CONTROL SYSTEM

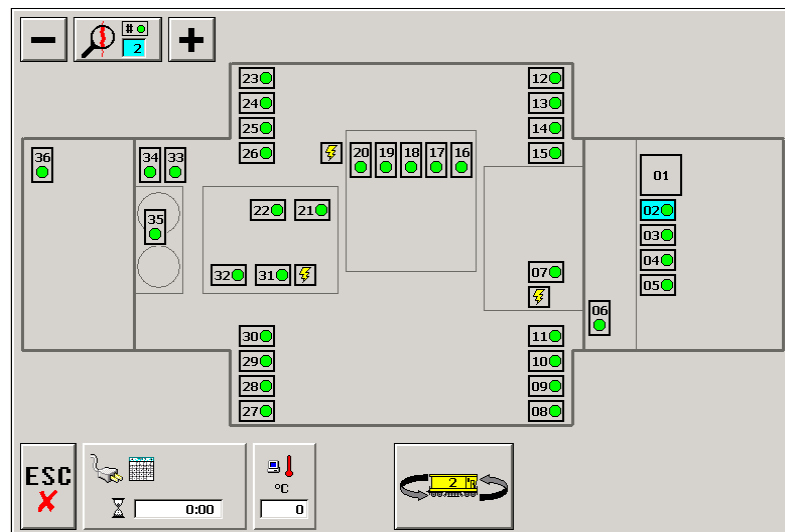
- 16.1. The cab is equipped with all the necessary controls and instruments required for grinding, traveling, and communicating.



Operator Workstation Controls Example

- 16.1.1. Traveling controls include a speedometer, tachometer, speed control, brake control, lighting switches, horn control, and other instruments and gauges required for track traveling. The gauges are in electronic form and shown on the computer monitor. Gauges for engine information such as oil pressure, water temperature, and system voltage are shown in histogram format. The histograms show how the item has varied over the past 60 minutes.

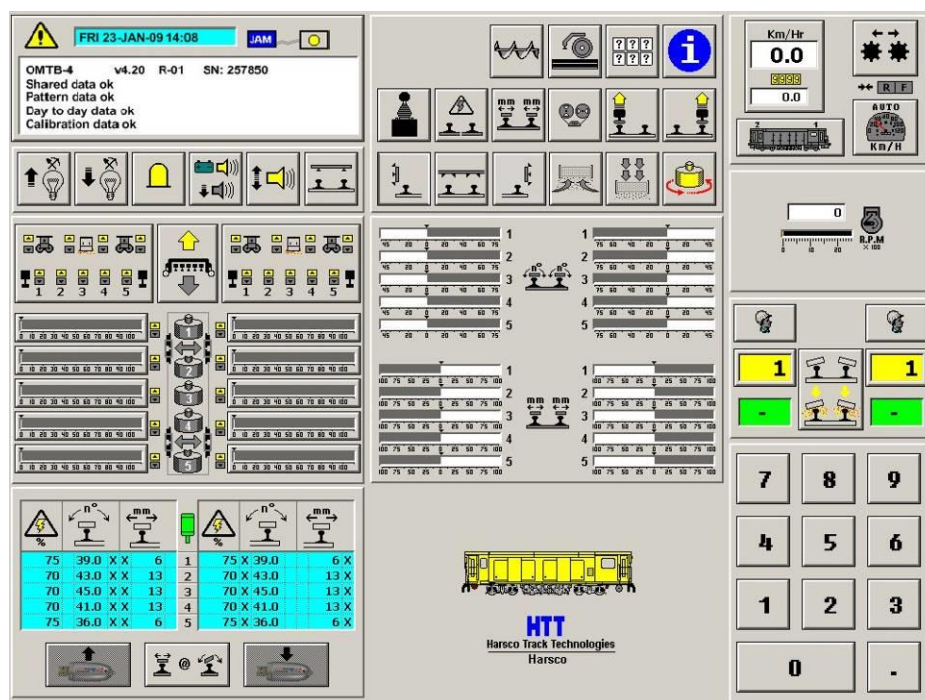
- 16.2. The main computer for the 8-stone machine is located in the cab and communicates with the various sensors, switches, and valves on the machine through nodes, which are linked together in a network based on the CAN protocol. This proprietary control system is referred to as “Jupiter II.”



Network Layout

- 16.2.1. Each node (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 and threaded connectors. All components and cables mounted outside of the cab are sealed with a rating of IP-65 or better.
- 16.3. 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.
- 16.4. 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.



Main Control Screen (10-stone)

- 16.5. 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.
- 16.6. 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.
- 16.7. “Cruise control” keeps the machine at a constant pre-set speed during a given grinding pass.

- 16.8. 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 around 2 km/hr.

17. VIDEO CAMERA AND MONITOR

- 17.1. 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. Video camera is mounted in an environmentally protected enclosure and is tilted up and down with an air cylinder. The color LCD monitor reverts the image automatically to preserve proper left/right orientation.

18. COUPLERS

- 18.1. The rail grinder shall be capable of being towed in a recovery role situation. Towing coupler installation will be designed to accommodate the customer coupler design specification on receipt of information from customer. Customer couplers will also be installed at the factory if provided by customer as a free issue item.

19. OPERATION

- 19.1. All controls are located to enable one person to operate the rail grinder, including travel to and from the job site.
- 19.2. The complete rail grinding operation does not require a crew larger than two personnel under normal operating conditions.

20. EXTERIOR NOISE LEVEL

- 20.1. The maximum noise level under full load does not exceed 77 dBA measured at 15 m (50 feet) in any direction from the centerline of the track when operated in a free field environment.

21. OPTIONAL EQUIPMENT

21.1. Dust Collection System:

21.1.1. Airborne dust is contained in the grinding carriage area and collected to minimize emissions to the atmosphere. Dust laden air travels through ductwork from the grinding area to a filter unit which cleans the air with direct filtration media principles. The collected dust falls into a dust collection hopper with a removable drawer for easy disposal. The drawer has capacity for over 8 hours of grinding. A hydraulically drive centrifugal fan pulls the air through the ductwork and filter unit. The dust collects on the outer surface of the filters and is then automatically purged with a blast of compressed air inside the filter. Clean air is exhausted out the top of the collection module.

21.2. Grinding Stones:

21.2.1. Grinding performance, both in metal removal and rail finish, is very much dependent on the quality of the grinding stone. Harsco Track Technologies has spent years developing grinding stones to meet customer expectations.

21.3. Rail Profile Measurement System:

21.3.1. The machine can be equipped with a profile measurement system which uses lasers and cameras to generate a digital image of the rail profile and record these images at 1-meter intervals along the track.

21.3.2. The images are displayed in real time on a monitor in the operator's cab and can be compared to any one of the profiles in a library of standard profiles.

21.3.3. The profile data can be printed in the machine cab or transferred to another computer for office analysis.



(Optional) Profile Measurement System Camera/Laser Units

22. STANDARD AND MISCELLANEOUS EQUIPMENT AND SPARE PARTS

22.1. The rail grinder consists of all equipment to make a complete standard installation, and miscellaneous equipment as covered in these specifications including all spare parts and tools offered as standard. Miscellaneous equipment includes the following:

- 22.1.1. Air horn, operated from the operator's control station;
- 22.1.2. Fire extinguisher;
- 22.1.3. All safety and warning signs and decals;
- 22.1.4. Adequate enclosed storage for spare parts, including grinding stones and tools.