



OPERATOR'S MANUAL

Microtunneling System Long Distance Control Container

**Supplement for the
Microtunneling System Periphery Drive
Operator's Manual**

Control Container SN: FA22242F

Publication No. 050176A

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SERVICE • RELIABILITY • INNOVATION

NOTES

DANGER

This machine is powered by high voltage electricity.



Failure to lockout/tagout power before servicing will cause severe personal injury or death.

LOCKOUT/TAGOUT main power supply before servicing. ONLY a qualified and trained technician can operate this equipment. Electrical repairs must be performed only by a certified electrician.

DANGER

This machine is equipped with an accumulator.



Escaping oil or other fluids under pressure can penetrate your skin causing serious injury or death.

If accumulator requires repair, ONLY a certified service technician can check and fill the accumulator with dry nitrogen. Refer to the accumulator manufacturer for more information. NEVER FILL AN ACCUMULATOR WITH OXYGEN! An explosion WILL occur if oil and oxygen mix under pressure, resulting in serious injury or death. Also, NEVER fill accumulator with compressed air. Compressed air can cause premature wear to the accumulator seals.

Introduction

This supplement for the Akkerman Microtunneling System Periphery Drive Operator's Manual (Publication No. 050132A) contains important safety, control and operation information for the Microtunneling Long Distance Control Container (SN FA22242F). You must read and understand this manual, the Microtunneling System Periphery Drive Operator's Manual and any other support equipment manuals before you operate and maintain this equipment. Keep this manual in your Control Container at all times. Additional copies of this manual may be purchased from the Akkerman Aftermarket Support Department, or downloaded from the Akkerman web site at www.akkerman.com.

The contractor is responsible for the overall safety program on the job site. Use this manual as a part of the safety program.

The use of parts other than genuine Akkerman parts could affect the efficient performance of the Microtunneling System. ALWAYS use genuine Akkerman parts.

Understand safety signal words, DANGER, WARNING, CAUTION, SAFETY INSTRUCTIONS, and NOTICE. When you see these words in this manual or on safety decals mounted on your equipment, follow the safety message to avoid personal injury and/or property damage.

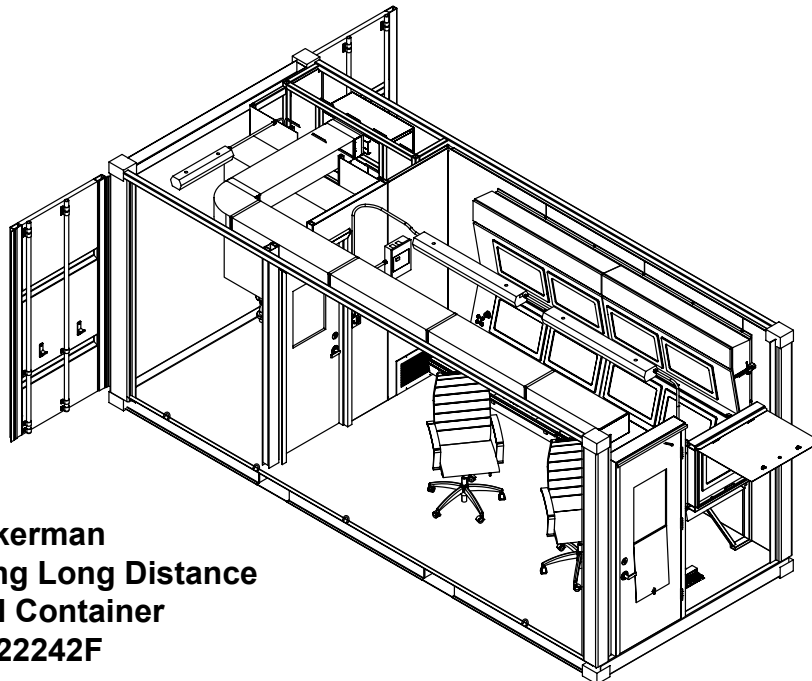
▲ DANGER Indicates an extremely hazardous situation which, if not avoided, WILL result in death or serious injury.

▲ WARNING Indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.

▲ CAUTION Indicates a potentially hazardous situation, which, if not avoided, MAY result in minor or moderate injury. It may also be used to alert against unsafe practices.

SAFETY INSTRUCTIONS Usually consists of individual messages stating procedures or actions that must be followed for the safe operation of a product.

NOTICE Identifies potential property damage and important installation, operator, or maintenance information.



**Akkerman
Microtunneling Long Distance
Control Container
FA22242F**

If you find any errors with this manual or have suggestions for improvement, please let us know. Email your comments via the Akkerman web site (Contact Us web page), or mail your suggestions to: Akkerman Inc, ATTN: Technical Publications, 58256 266th Street, Brownsdale, MN 55918.

Akkerman Inc. reserves the right to improve its product without notice or obligation.

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NOTES

Safety

BE ALERT FOR SAFETY INFORMATION

When you see this safety alert symbol on your equipment or in this manual, be alert to the possibility of personal injury or property damage.

Read all safety information.

Keep safety decals clean and in good condition. Replace missing or damaged safety decals.



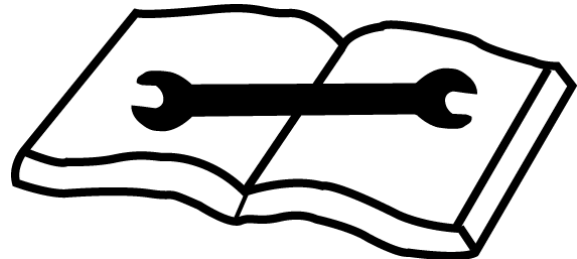
**ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!**

READ OPERATOR'S MANUAL

⚠ WARNING Unsafe operation or maintenance can cause severe injury or death.

Read and understand this manual and the Microtunneling System Periphery Drive Operator's Manual before operating or servicing this equipment.

Any unauthorized modifications will void the warranty.



WEAR PROTECTIVE CLOTHING

Wear OSHA approved protective clothing, such as hard hat, gloves, safety goggles, earmuffs or ear plugs, face shield, and steel-toed boots, when operating and servicing this equipment.

Wear reasonably close fitting clothing and remove jewelry before working on or near this equipment. This will help prevent the danger of catching them in moving parts or controls.



WORKING WITH ELECTRICAL EQUIPMENT

⚠ DANGER HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH.

Failure to follow these instructions will result in death or serious injury.

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.



PROPERLY GROUND ELECTRICAL EQUIPMENT

⚠ DANGER Improper grounding can result in equipment damage or electrical shock, causing severe injury or death.

Be sure equipment is properly ground before engaging power.



LOCKOUT/TAGOUT POWER BEFORE SERVICING

⚠ DANGER Failure to lockout/tagout power before servicing will cause severe personal injury or death.

LOCKOUT/TAGOUT main power supply before servicing. Electrical repairs must be performed only by a certified electrician.



HYDRAULIC OIL/FLUIDS UNDER PRESSURE

⚠WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury or death.

Release all pressure before performing maintenance or repairs. Never weld near pressurized fluid lines.

DO NOT use your hands to check for leaks. When searching for leaks, use a piece of wood or cardboard.

Contact medical help immediately if any oil or fluid is injected into your skin. A serious infection or reaction can emerge without proper medical treatment.



BEWARE OF SUSPENDED LOADS

⚠WARNING Suspended loads may fall and cause severe personal injury or death.

If a hydraulic hose from the boom of a crane or excavator breaks, the boom can fall instantly.

Do not enter area under or around a load.



KEEP PERSONNEL AWAY FROM MOVING PARTS

⚠WARNING Crushing hazard. Keep personnel away from inside of jacking frame. Failure to do so could result in serious personal injury or death.



INSPECT ELECTRICAL CONNECTIONS

⚠ WARNING Regularly inspect electrical connections to be sure they are secure. Failure to do so could cause an explosion if moisture enters an unsecured electrical connection.



USING TUNNEL POWER CABLE

⚠ DANGER NEVER disconnect tunnel power cables when tunnel power is ON. Doing so WILL cause severe injury or death from electrical shock.



CONTACT WITH POWER CABLE

⚠ DANGER Contact with a severed or damaged electrical cable WILL cause serious injury or death.

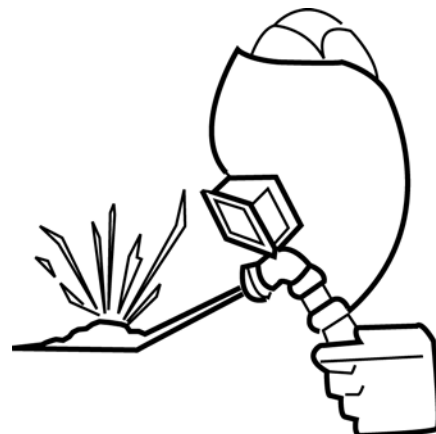
CONSTANTLY monitor electrical cables during drive to prevent cutting or stretching of any electrical cables.



UNAUTHORIZED WELDING

⚠ WARNING Unauthorized welding can cause structural failure resulting in possible injury or death.

Do not weld on any structural member. Unauthorized welding or repair will void the warranty.



PRACTICE SAFE MAINTENANCE

⚠WARNING Unexpected equipment movement may cause serious personal injury.

LOCKOUT/TAGOUT power before performing any maintenance.

Shut down equipment before making repairs, adjustments, or removing obstructions.

Only trained and qualified personnel should perform any maintenance or repairs.

Keep the area around the equipment clean and dry when performing maintenance.

Do not service the machine while it is in motion.

Replace worn or damaged parts. Remove grease, oil, or debris buildup.



TEST TUNNEL VENTILATION

⚠WARNING Keep MTBM, tunnel and shafts well ventilated at all times.

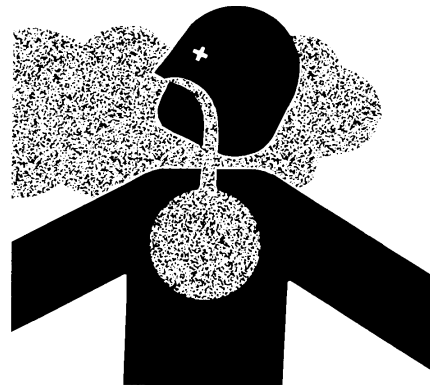
Use an approved air analyzer to detect hazardous gases and oxygen content.

Before and during the shaft operation, test for combustible and toxic gases and oxygen deficiency.

If the levels exceed OSHA prescribed levels, leave tunnel and shaft immediately! Do not activate or deactivate any electrical or hydraulic devices, since any spark could cause an explosion.

Once ALL personnel are out of tunnel/shaft, cut power from power source.

Gases must be removed before reentering tunnel/shaft.



AVOID PINCH POINTS

⚠ WARNING Contact with moving parts or the mishandling of parts can cause severe personal injury.

Keep hands away from moving parts.

Watch your fingers, hands, and legs while equipment is in operation.

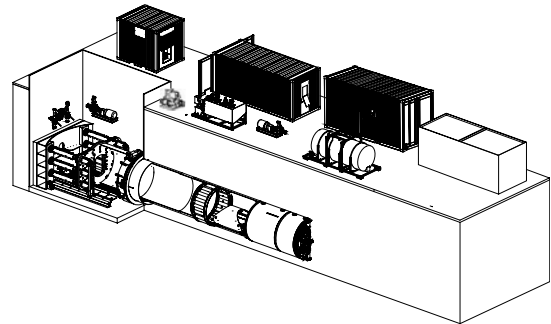
Handle parts carefully to avoid crushing and pinch point hazards.



REGULARLY CLEAN AND INSPECT EQUIPMENT

Remove any grease, oil, or debris buildup to avoid potential injury or equipment damage.

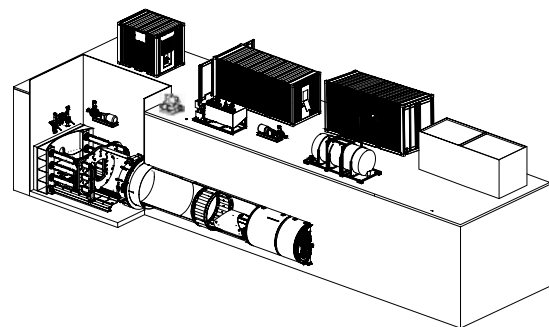
Inspect equipment for damage. If damaged, repair or replace immediately.



HIGH PRESSURE HYDRAULICS

⚠ WARNING The Microtunneling System contains high pressure hydraulics.

Keep all guards in place.



SLIPPERY WHEN WET

⚠ WARNING Slips and falls can cause serious personal injury.

Ensure firm footing in wet or slippery conditions.

Replace skid-resistant material if it is damaged or missing to prevent slips and falls.

Remove any buildup of grease, oil, or debris.



FIRE PREVENTION

⚠ CAUTION Fires can cause injury or property damage.

Keep equipment clean. Remove all debris from equipment.

Have a fire extinguisher available at all times. Keep the fire extinguisher fully charged.



NO SMOKING IN SHAFT OR TUNNEL

⚠ WARNING Smoking in shaft or tunnel could cause an explosion if combustible gases are present.

Do not smoke in shaft or tunnel.



KEEP JOB SITE CLEAN AND ORGANIZED

⚠ WARNING Tripping can cause serious personal injury.

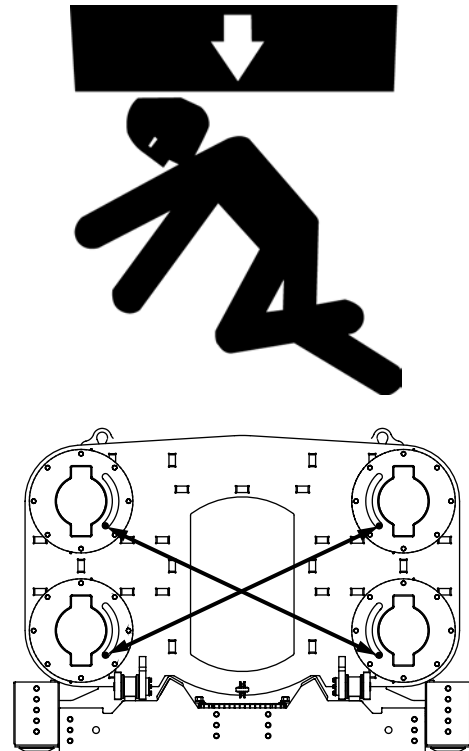
Be sure to keep job site clean and organized.



PREPARE JACKING FRAME

⚠ WARNING Lifting or shipping jacking frame without ALL cylinders locked into frame can cause serious injury or death from sliding thrust block.

BEFORE lifting or shipping frame, ALL cylinders must be locked using cam lock levers.

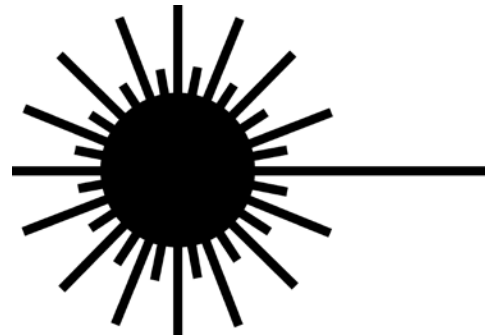


AVOID LASER LIGHT EXPOSURE

⚠ DANGER Staring into laser light will cause severe injury.

Do not stare into laser guidance system light beam. Avoid direct eye exposure.

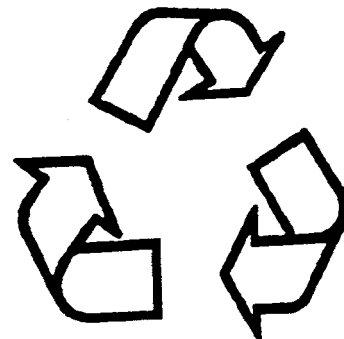
To avoid possible exposure to radiation in excess of acceptable emission limits, all repairs to laser must be performed by the original manufacturer or an authorized service technician.



RECYCLE WASTE

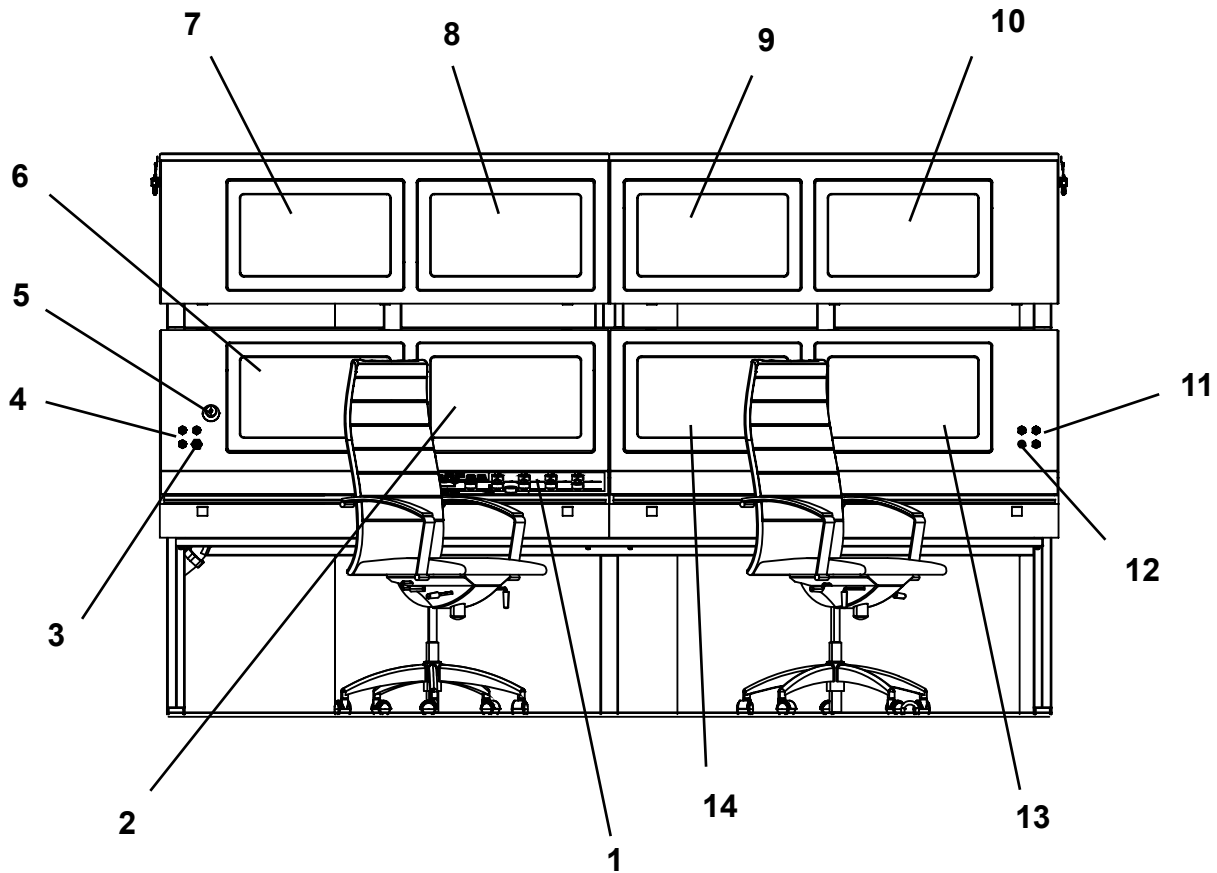
Follow local, state, federal, and international regulations when recycling or disposing of waste. Waste includes fluids/oil, fuel, filters, coolant, and batteries.

Use leakproof containers when draining fluids/oil. Do not pour waste on the ground, down a drain, or into any water source.



Controls

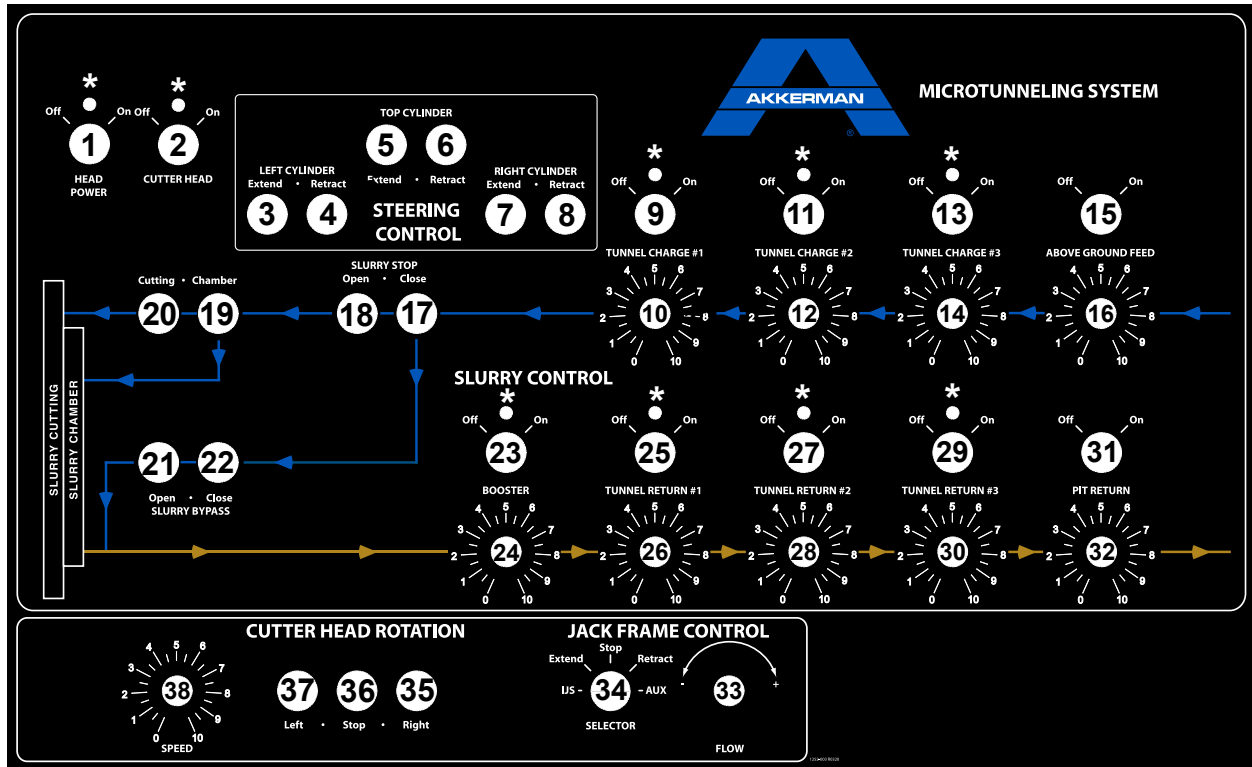
CONTROL CONSOLE



- 1. Control Console
- 2. Target Screen Monitor
- 3. Ethernet Port
- 4. USB Ports (3)
- 5. Emergency Stop
- 6. Control Screen Monitor
- 7. Control Console Monitor #1

- 8. Control Console Monitor #2
- 9. Auxiliary Console Monitor #3
- 10. Auxiliary Console Monitor #4
- 11. USB Ports (3)
- 12. Ethernet Port
- 13. Auxiliary Console Monitor #2
- 14. Auxiliary Console Monitor #1

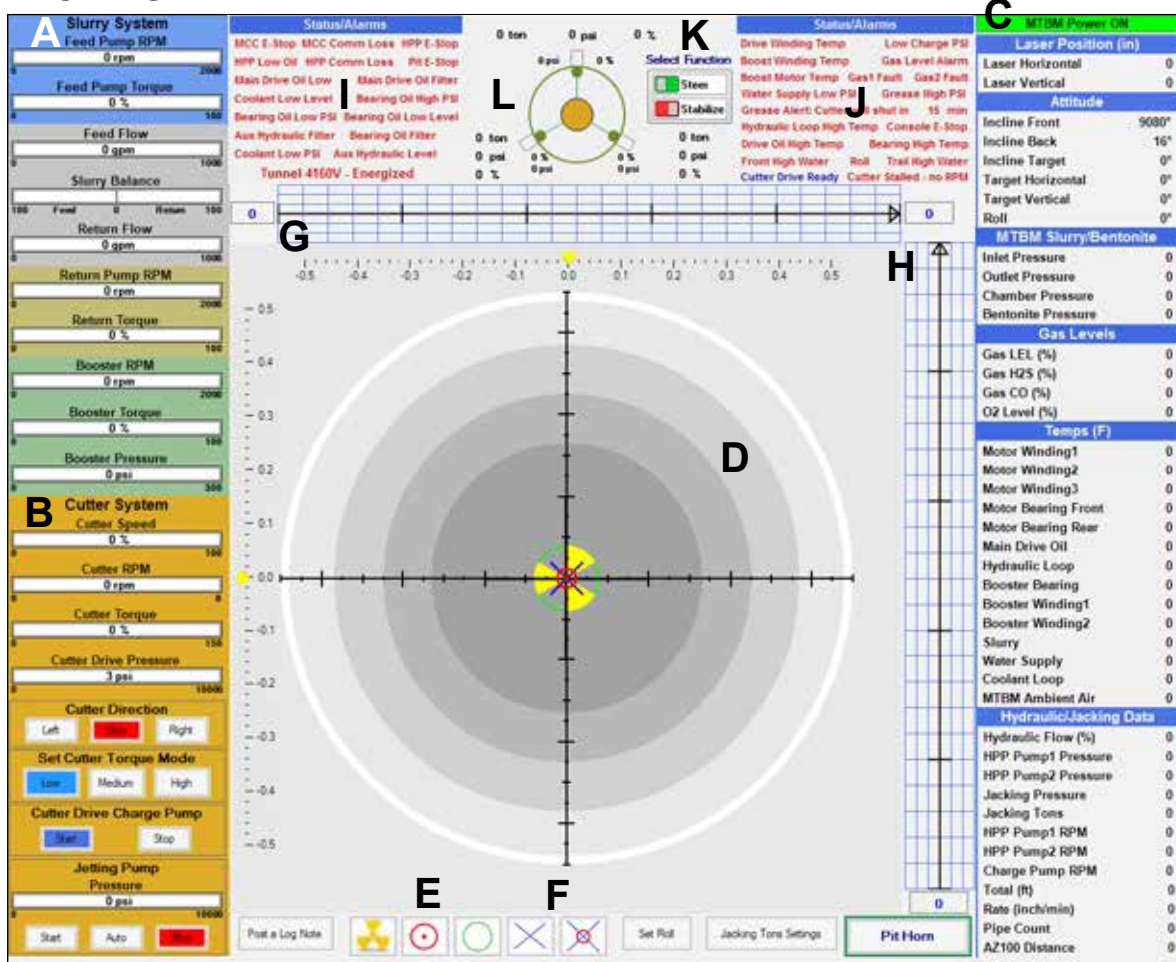
CONSOLE CONTROLS



- | | |
|---|--|
| 1. Head Power Control | 21. Slurry Bypass Valve - Open |
| 2. Cutter Head Control | 22. Slurry Bypass Valve - Close |
| 3. Left Steering / Stabilizer Cylinder - Extend | 23. Booster Pump Control |
| 4. Left Steering / Stabilizer Cylinder - Retract | 24. Booster Pump Flow Control |
| 5. Top Steering / Stabilizer Cylinder - Extend | 25. Tunnel Return Pump #1 Control |
| 6. Top Steering / Stabilizer Cylinder - Retract | 26. Tunnel Return Pump #1 Flow Control |
| 7. Right Steering / Stabilizer Cylinder - Extend | 27. Tunnel Return Pump #2 Control |
| 8. Right Steering / Stabilizer Cylinder - Retract | 28. Tunnel Return Pump #2 Flow Control |
| 9. Tunnel Feed Charge #1 Control | 29. Tunnel Return Pump #3 Control |
| 10. Tunnel Feed Charge #1 Flow Control | 30. Tunnel Return Pump #3 Flow Control |
| 11. Tunnel Feed Charge #2 Control | 31. Pit Return Pump Control |
| 12. Tunnel Feed Charge #2 Flow Control | 32. Pit Return Pump Flow Control |
| 13. Tunnel Feed Charge #3 Control | 33. Jack Frame Flow Control |
| 14. Tunnel Feed Charge #3 Flow Control | 34. Jack Frame Selector Control |
| 15. Above Ground Feed Pump Control | 35. Cutter Head Rotation - Right |
| 16. Above Ground Feed Pump Flow Control | 36. Cutter Head Rotation - Stop |
| 17. Slurry Stop Valve - Close | 37. Cutter Head Rotation - Left |
| 18. Slurry Stop Valve - Open | 38. Cutter Head Rotation Speed Control |
| 19. Slurry Control Chamber Valve | |
| 20. Slurry Control Cutting Nozzle Valve | |

* Indicator light illuminates when the power cable is properly connected and grounded.

TARGET SCREEN



The right portion of the target screen shows all critical tunneling data by means of graphical and numeric meter displays. For example, the Slurry System (A) and Cutter System (B) meter information is represented with bar graphs. The MTBM operational meter information (C) is represented with numeric values.

Each meter has a menu that allows the operator to set a colored visual alarm if certain specifications are met or exceeded. Simply click on the meter desired and the preferences menu will appear. Change the limit on the visual alarm as needed and click OK.

The center area of the target screen (D) shows a graphical representation of the position of the MTBM cutter head, target position, and projected cutter head position. The buttons (E) on the bottom of the screen turn these graphics on or off. There are also two marker buttons (F); one is the Operator Resettable Marker to set the marker on the laser position, and the other button removes the Operator Resettable Marker from the screen. These buttons make it easier to see how the MTBM is responding to steering.

Grids around center area of the target screen are the Akkerman AZ100 guidance system data plots for the previous 25 feet of the x (line [G]) and y (grade [H]) coordinates.

Locations (I & J) are the Alarm Message fields.

The location (I) **alarm messages** include the: MCC E-Stop, MCC Comm Loss, HPP E-Stop, HPP Low Oil, HPP Comm Loss, Pit E-Stop, Main Drive Oil Low, Main Drive Oil Filter, Coolant Low Level, Bearing Oil High PSI, Bearing Oil Low PSI, Bearing Oil Low Level, Aux Hydraulic Filter, Bearing Oil Filter, Coolant Low PSI, Aux Hydraulic Level and Tunnel 4160V - Energized.

The location (J) **alarm messages** include the: Drive Winding Temp, Low Charge PSI, Boost Winding Temp, Gas Level Alarm, Boost Motor Temp, Gas1 Fault, Gas2 Fault, Water Supply Low PSI, Grease Low PSI, Grease High PSI, Grease Alert: Cutter will shut in 15 min, Hydraulic Loop High Temp, Console E-Stop, Drive Oil High Temp, Bearing High Temp, Front High Water, Roll, Trail High Water, Cutter Drive Ready and Cutter Stalled - no RPM

The Select Function (K) Steer / Stabilize switches controls whether the Steering Controls on the console of the control container operate the steering cylinders or the stabilizer cylinders.

The Steering Cylinder/Stabilizer indicator (L) displays the MTBM steering cylinder stroke position in percent, pressure in PSI for the top, left, and right cylinders and the steering pressure in tons. In addition, the stabilizer stroke position in percent, and the pressure in PSI for the top, left, and right stabilizers is also displayed. The indicator graphical reference is viewed from the launch shaft going forward to the reception shaft.

(continued on next page)

SLURRY SYSTEM (A)

Feed Pump (B)

Displays a visual representation of the feed pump RPM and torque operation. The feed pump is controlled with Above Ground Feed pump control in the control container.

Feed Flow / Slurry Balance / Return Flow (C)

Displays a visual representation of the feed and return flow in GPM. The Slurry Balance displays the GPM difference of the return and feed flow.

Return Pump (D)

Displays a visual representation of the return pump RPM and torque operation. The return pump is controlled with Pit Return pump control in the control container.

Booster Pump (E)

Displays a visual representation of the booster pump (located in the trailing section) RPM, torque and pressure operation. The booster pump is controlled with Booster pump control on the console in the control container.

CUTTER SYSTEM (F)

Displays a visual representation of the cutter system speed, RPM, torque and cutter drive pressure operation. The cutter rotation is controlled with Cutter Head Rotation controls on the console in the control container.

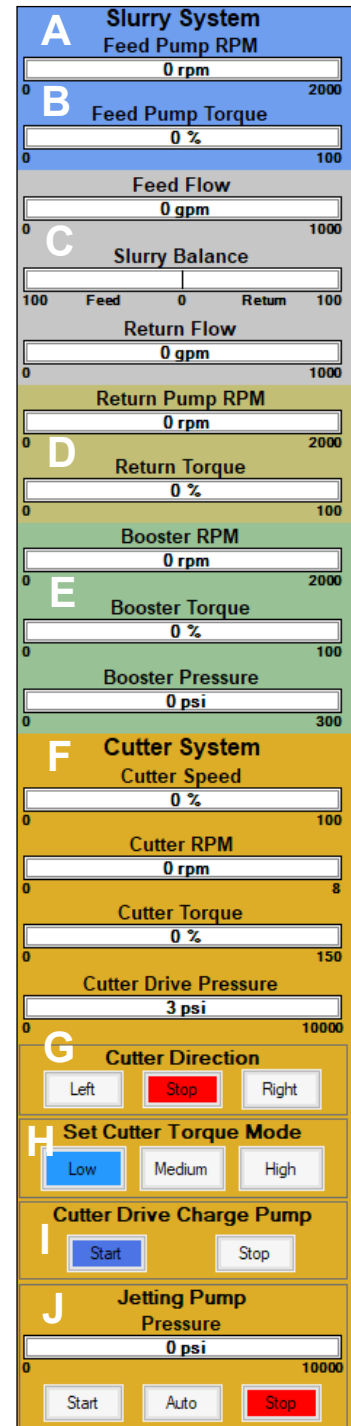
Cutter Direction (G): displays a visual representation of the cutter direction selected from the Cutter Head Rotation controls on the console in the control container.

Set Cutter Torque Mode (H): the six, 2 speed drive motors allow the operator the ability to control the cutter torque with the drive motors versus reducing jacking speed. **Low torque:** 6 motors in high speed, **Medium torque:** 3 motors in low speed and 3 motors in high speed, **High torque:** 6 motors in low speed. Depending on ground conditions and jacking speed, reducing jacking speed may be necessary to reduce cutter torque.

IMPORTANT: BEFORE changing motor torque mode, the cutter head speed must be at 0 rpm, otherwise the drive motor seals will be damaged due to high case drain pressure.

Cutter Drive Charge Pump (I): displays a visual representation of the operation of the cutter drive charge pump. When the Cutter Head control on the console in the control container is turned on, the cutter drive charge pump will automatically start after the main drive comes up to speed.

Jetting Pump (J): controls the start and stop of the high pressure jetting pump. The Auto setting will automatically start and stop with the cutter head rotation.



(continued on next page)

MTBM POWER (A)

The MTBM power indicator displays the head power to the MTBM, either ON (green) or OFF (red).

LASER POSITION (Inch) (B)

The **Laser Horizontal** and **Laser Vertical** meters, measure the deviations in inches of the laser spot with reference to the center of the target grid. Positive vertical deviation indicates that the laser spot is above the center of the target grid and positive horizontal deviation indicates that the laser spot is right of the center of the target grid.

ATTITUDE (C)

Incline Front measures the degree of incline from level position for the MTBM front section (in front of the steering band). A positive value indicates that the front (cutter bit) is higher than the back of the front section.

Incline Back measures the degree of incline from level position for the MTBM front section (behind the steering band). A positive value indicates that the front (steering band) is higher than the back of the front section.

Incline Target measures the degree of incline from level position for guidance target. A positive value indicates that the front (cutter bit end) of the target is higher than the back (lens) end.

Target Horizontal measures the degree of horizontal angle for the guidance target with respect to the laser beam. A positive value indicates that the front (cutter bit) end of the target is more to the right than the back (lens) end.

Target Vertical measures the degree of vertical angle for the guidance target with respect to the laser beam. A positive value indicates that the front (cutter bit) end of the target is higher than the back (lens) end.

Roll indicates the degree of clockwise or counterclockwise roll of the MTBM. A negative reading indicates that the machine has rolled counterclockwise as viewed from the rear of the MTBM. A positive reading indicates that the machine has rolled clockwise as viewed from the rear of the MTBM. To change roll meter (refer to Roll Preferences graphic [D]), click the roll field, change the degree setting (Adjustment) and update rate (milliseconds) and press Ok button. If the degree setting parameters are exceeded, the main drive motor (rotation) and main hydraulic pump (jacking) will be shut down and the stop valves will cycle.

The roll positive and negative values can be set independently by clicking the Set Roll button on the bottom right portion of the target screen (refer to Roll Setting graphic [E]). Change the degree settings and click Set button.

MTBM SLURRY/BENTONITE (F)

The slurry pressure:

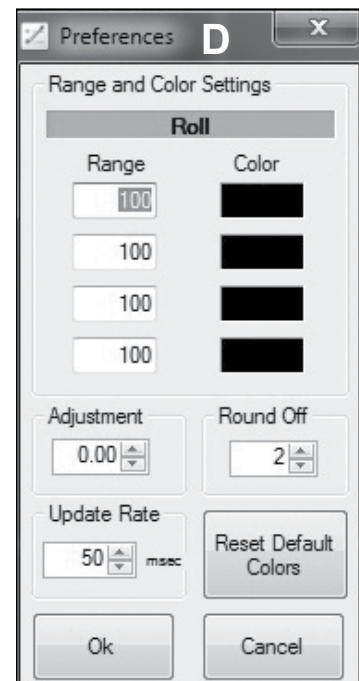
Inlet Pressure displays the slurry pressure in PSI as monitored at the inlet stop valve.

Outlet Pressure, displays the slurry pressure in PSI as monitored at the outlet stop valve.

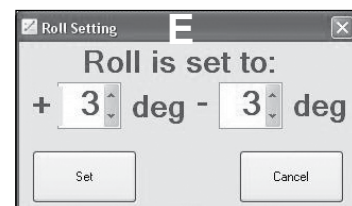
Chamber Pressure displays the slurry pressure (earth pressure) in PSI as monitored at the MTBM slurry chamber.

Bentonite Pressure displays the lubrication pressure in PSI of the lubrication manifold in the MTBM.

A MTBM Power ON	
B Laser Position (in)	
Laser Horizontal	0
Laser Vertical	0
C Attitude	
Incline Front	9080°
Incline Back	16°
Incline Target	0°
Target Horizontal	0°
Target Vertical	0°
Roll	0°



Roll Preferences



Roll Setting Meter

F MTBM Slurry/Bentonite	
Inlet Pressure	0
Outlet Pressure	0
Chamber Pressure	0
Bentonite Pressure	0

(continued on next page)

GAS LEVELS (A)

Gas LEL (%) displays the % of LEL (Lower Explosive Limit) gas concentration in the front section.

Gas H2S (%) displays the % of H2S (Hydrogen Sulfide) gas concentration in the front section.

Gas CO (%) displays the % of CO (Carbon Monoxide) gas concentration in the front section.

O2 Level (%) displays the % of oxygen concentration in the front section.

A Gas Levels	
Gas LEL (%)	0
Gas H2S (%)	0
Gas CO (%)	0
O2 Level (%)	0

To change the gas setting alarms, open the SL100 Front Editor program.

Update the Gas Alarm Settings by changing the High/Critical or Low/High % fields per job requirements (refer to Gas Alarm Settings graphic below). Then click Validate.

The screenshot shows four panels for gas alarm settings. Each panel has two input fields with spinners and a percentage sign. The values shown are: Gas LEL (High: 10, Critical: 20), Gas H2S (High: 10, Critical: 20), Gas CO (High: 10, Critical: 20), and Gas O2 (Low: 19, High: 23).

TEMPS (F) (B)

Motor Winding1 , 2 & 3 displays the temperature (Fahrenheit) of the 500 HP electric motor windings.

High temperature is 250°F (121°C) (default), critical temp. 300°F (149°C).

Motor Bearing Front & Rear displays the temperature (Fahrenheit) of the 500 HP electric motor bearings.

High temperature is 130°F (54°C) (default), critical temp.150°F (66°C).

Main Drive Oil displays the internal temperature (Fahrenheit) of the main drive hydraulic reservoir oil.

High temperature is 140°F (60°C) (default), critical temp.160°F (71°C).

Hydraulic Loop displays the temperature (Fahrenheit) of the hydrostatic loop between pump and motors (main drive hydraulic loop).

High temperature is 160°F (71°C) (default), critical temp.180°F (82°C).

Booster Bearing displays the internal temperature (Fahrenheit) of the booster motor bearing in the trailing section.

High temperature is 130°F (54°C) (default), critical temp.150°F (66°C).

Booster Winding1 & 2 displays the temperature (Fahrenheit) of the booster electric motor windings.

High temperature is 250°F (121°C) (default), critical temp. 300°F (149°C).

Slurry displays the temperature (Fahrenheit) of the incoming slurry as it enters the front section stop/bypass valves.

Water Supply displays the temperature (Fahrenheit) of the incoming water supply in the MTBM front section.

Coolant Loop displays the temperature (Fahrenheit) of the Propylene Glycol motor cooling reservoir.

MTBM Ambient Air displays the ambient air temperature (Fahrenheit) in the MTBM starting section.

B Temps (F)	
Motor Winding1	0
Motor Winding2	0
Motor Winding3	0
Motor Bearing Front	0
Motor Bearing Rear	0
Main Drive Oil	0
Hydraulic Loop	0
Booster Bearing	0
Booster Winding1	0
Booster Winding2	0
Slurry	0
Water Supply	0
Coolant Loop	0
MTBM Ambient Air	0

(continued on next page)

HYDRAULIC/JACKING DATA (A)

The following display values depend on whether the remote hydraulic power pack or jacking can is selected:

- **Hydraulic Flow (%)** displays the hydraulic pump flow rate from the remote hydraulic power pack or jacking can.
- **HPP Pump1 Pressure** displays the hydraulic power pack pump 1 pressure in PSI.
- **HPP Pump2 Pressure** displays the hydraulic power pack pump 2 pressure in PSI.
- **Jacking Pressure** displays the extension pressure of the main jacking cylinders on the jacking frame from the hydraulic power pack or the extension pressure of the jacking can thrust cylinders from the jacking can.
- **Jacking Tons** displays the calculated tons of thrust that is being applied to the pipe by the jacking frame cylinders from the hydraulic power pack or the thrust cylinders from the jacking can.

HPP Pump1 RPM displays the hydraulic power pack pump 1 motor rpm.

HPP Pump2 RPM displays the hydraulic power pack pump 2 motor rpm.

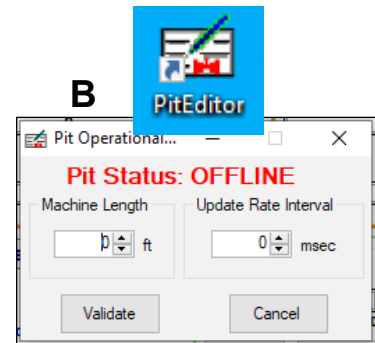
Total (ft) displays the total linear feet that have passed the pipe length wheel counter.

Rate (inch/min) measures the jacking frame advancement rate in inches per minute.

Pipe Count displays the number of pipe that have been installed. To ensure an accurate pipe count, the machine length must be updated in the PitEditor program (refer to PitEditor Program graphic [B]).

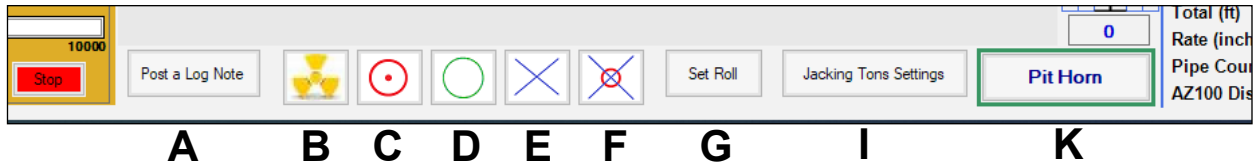
AZ100 (Target) Distance displays the total linear feet from jacking shaft wall (guidance system) to MTBM target.

A Hydraulic/Jacking Data	
Hydraulic Flow (%)	0
HPP Pump1 Pressure	0
HPP Pump2 Pressure	0
Jacking Pressure	0
Jacking Tons	0
HPP Pump1 RPM	0
HPP Pump2 RPM	0
Charge Pump RPM	0
Total (ft)	0
Rate (inch/min)	0
Pipe Count	0
AZ100 Distance	0



*PitEditor Program
Machine Length Value*

(continued on next page)



The bottom portion of the target screen allows the operator to post a note, control target screen graphics (MTBM cutter head, target position, and projected MTBM position), and set the roll and jacking ton parameters.

Post a Note (A)

Click this button to type a short note. Click POST button to save this note on the database. This note will be generated on a report providing the note was posted within the date and time parameters of the report.



MTBM Cutter Head Position (B)



Target Position (C)



Projected Cutter Head Position (D)



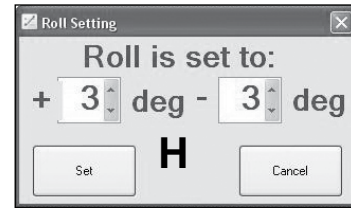
Operator Resettable Laser Position Marker (E)



Remove Operator Resettable Marker (F)

Set Roll (G)

Roll indicates the degree of clockwise or counterclockwise roll of the MTBM. If the degree setting parameters are exceeded, the main drive motor (rotation) and main hydraulic pump (jacking) will be shut down. The roll positive and negative values can be set independently by clicking the Set Roll button (G) on the target screen (refer to Roll Setting graphic [H]). Once the degree settings are changed, click Set button. The calculated Roll is displayed on the target screen under the Attitude heading.



Roll Setting Meter

Adaptive Roll (auto roll reset) is equipped with this system. If roll is exceeded and the MTBM system shuts down, the operator can increase the roll settings to be able to continue to mine to bring the roll back to the original parameters. Once the roll is back to within $\pm 2^\circ$ roll, the program will automatically reset the roll back to the original $\pm 3^\circ$ degree parameter setting.

Jacking Tons Settings (I)

The jacking cylinder diameter and number of cylinders value fields (refer to Jacking Settings graphic [J]) are used to properly calculate the jacking tonnage during the jacking process. The calculated Jacking Tons is displayed on the target screen under the Jacking/Piping heading.



Jacking Settings Meter

Check or update the jacking settings by clicking Jacking Tons Settings button (I).

CYLINDER DIAMETER

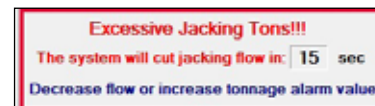
Adjust the Diameter of the jacking cylinders in inches by clicking the up and down arrows or by simply entering in the number.

NUMBER OF CYLINDERS

Adjust the Number of Cylinders by clicking the up and down arrows or by simply entering in the number of cylinders. Once settings are updated, click the Set button.

JACKING TONS ALARM SETTING

Adjust the tons by clicking the up and down arrows or by simply entering in the jacking ton value you want to receive an alarm at a specified jacking tonnage. The Excessive Jacking Tons!! alert appears on the Alarm Message field on the Target Screen.



PIT HORN (K)

Pit Horn allows the sounding of the pit horn operation in the launch shaft.

(continued on next page)

The controls on the left portion of the Target Screen can be activated with the mouse. Some of the controls on this screen are normally controlled from the control console.

Charge Pumps (A) (Slurry)

Displays a visual representation of the feed charge pump operation. The feed pumps are controlled with the corresponding Tunnel Charge Pump controls in the control container.

Return Pumps (B) (Slurry)

Displays a visual representation of the return pump operation. The return pumps are controlled with the corresponding Tunnel Return Pump controls in the control container.

Cutting Nozzle Valves (C)

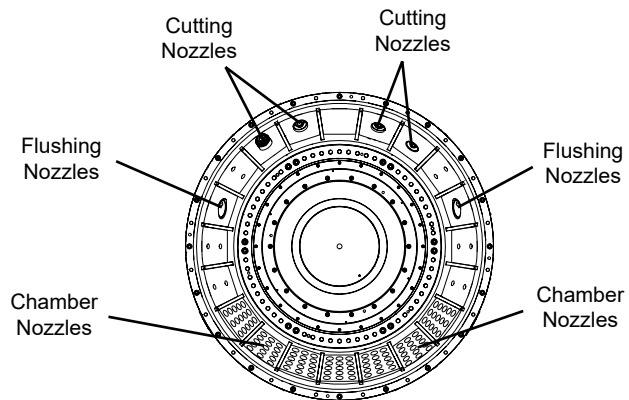
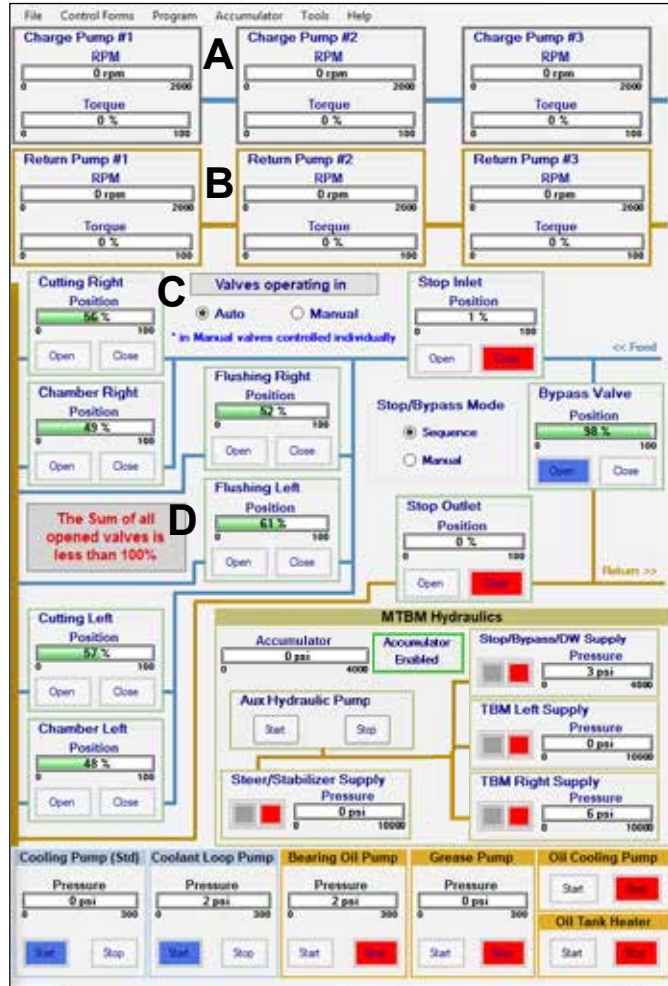
The cutting valves consist of the Cutting/Flushing and Chamber valves. The valves are typically controlled by using the Cutting and Chamber buttons on the console in the control container. They can also be controlled on the Target screen.

Auto Mode: The Cutting and Flushing valve positions are mirrored while the Chamber valve is opposite of the Cutting valve position.

Manual Mode: (Not recommended for normal operation.) Each nozzle valve will be operated individually, no automatic adjustments. If the sum of all opened valves is less than 100%, an alert message (D) will appear on the Target screen to warn the operator of potential high pressure buildup in the slurry lines which could cause the slurry lines to burst due to the restriction caused by the valve operation.

Valve Function: Hold the button down to vary the valve opening. The Position reading displays the position of the valve in percent. Opening the cutting/flushing valve will close the slurry chamber valve by the same amount. Closing this valve will open the slurry chamber valve by the same amount.

The Flushing valve can be adjusted by going into the Front Editor program and changing the Flushing Offset. Positive offset number is ahead of cutting, a negative offset number is behind cutting. Once set, click Validate.



Flushing Offset Adjustment in Front Editor Program

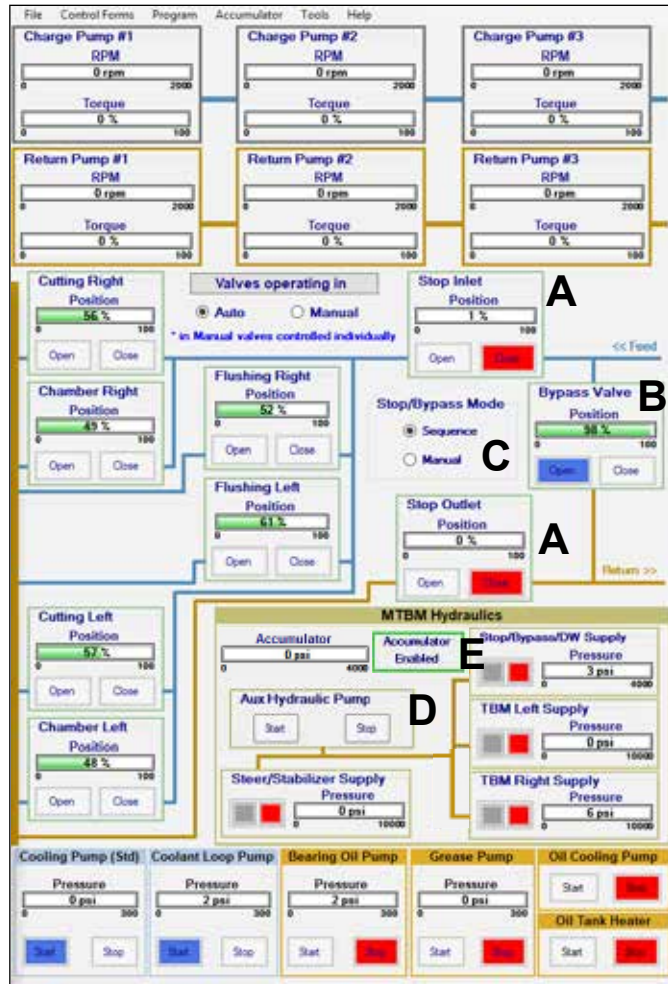
(continued on next page)

Inlet & Outlet Stop Valves (A): open or close the slurry stop valves. The stop valves are either fully open or fully closed (in sequence mode). The Position will display the valve position in percent; 0% (closed) or 100% (open). The stop valves are controlled by either pressing the buttons on the control screen or the slurry stop valve Open and Close buttons on the console in the control container.

Bypass Valve (B): open or close the slurry bypass valve. In sequence mode the bypass valve will either be fully open or fully closed. The Position will display the valve position in percent; 0% (closed) or 100% (open). In manual mode the valve position can be varied depending on operator. The Position will display the valve position in percent. The bypass valve is controlled by either pressing the buttons on the control screen or the bypass valve Open and Close buttons on the console in the control container.

Mode (C): Sequence mode is the default. Select **Sequence** (recommended) to operate the stop valve and bypass valve in opposite positions. When the stop valve is open, the bypass valve is closed and vice versa.

Select **Manual** (not recommended) to operate the stop valve and bypass valve independently of each other. Keep in mind, using this operation requires close monitoring of the slurry. Otherwise if both valves are closed, high pressure buildup in the slurry lines could cause the slurry lines to burst.



MTBM HYDRAULICS (D)

When the Head Power control (on control console) is on, all hydraulic MTBM control functions operate (steering cylinders, bypass valve, stop valve, cutting nozzles, dirt wings or stabilizers) when activated.

Aux Hydraulic Pump: controls the start and stop of the MTBM hydraulic pump in the MTBM front section. The pump will automatically start when a function is activated.

Stop/Bypass/DW Supply Valve: open or close the low pressure valve that controls the bypass valve, stop valve or dirt wings. The Pressure reading displays the valve oil pressure in PSI. This valve will automatically open when the stop valve, bypass valve, cutting nozzles or dirt wings are activated. The maximum pressure is 3,000 psi.

TBM Left / Right Supply Valves: open or close the low pressure valves that controls the cutting nozzles (Cutting/Flushing/Chamber). The Pressure reading displays the valve oil pressure in PSI. The valves will automatically open when the cutting nozzles are activated. The maximum pressure is 3,000 psi.

Steer/Stabilizer Supply: open or close the high pressure valve that controls the steering cylinders. The Pressure reading displays the valve oil pressure in PSI. This valve will automatically open when the steering cylinders are activated. The maximum pressure is 5,000 psi.

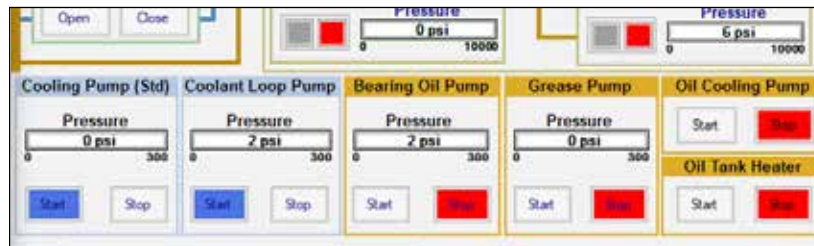
Accumulator PSI: displays the accumulator pressure in the front section. When the MTBM loses power, the accumulator will automatically close the slurry inlet and outlet stop valves and open the slurry bypass valve. The maximum pressure is 3,500 - 4,000 psi. **IMPORTANT: Before servicing the slurry stop and bypass valves or hydraulics, the accumulator MUST be manually deactivated and locked out.** The accumulator is always being monitored to retain the accumulator pressure at 2,500 - 3,000 psi. The pump will start at 2,500 psi and turn off at 3,000 psi. The pump can be disabled if needed only for testing or troubleshooting purposes. On the Target Screen, click Accumulator on menu bar, then select Disable **AND** manually disable MTBM accumulator and de-energize. **Never operate the MTBM with the accumulator pump disabled.**

When pump is disabled, the Accumulator Enabled display (E) will be grayed out.



(continued on next page)

Controls - Target Screen



Cooling Pump (Std/VFD): controls the start and stop of the above ground water cooling tank pump. The cooling pump will automatically start and stop with the cutter head rotation.

The Cooling Pump Pressure is also displayed.

At initial MTBM setup, the MTBM Selector program appears. Select the MTBM Cooling System for the job project follows:

- Standard (A)** if using the Akkerman Water Cooling Tank FA10030F
- VFD (B)** if using the Akkerman 1685 Water Cooling Tank FA10178F



Cooling Loop Pump (Glycol System): controls the start and stop of the cooling pump in the trailing section. The cooling pump will automatically start and stop when the Cutter Head Control switch is turned ON. The Cooling Pump Pressure is also displayed.

Bearing Oil Pump: turns the bearing oil pump on or off (located in the front section). The bearing oil pump recirculates oil through the bearing, bearing cavity, pump, filter, bearing oil manifold and then back through the bearing etc. The bearing oil pump automatically operates when the drive motor (cutter head rotation) is running.

The **Bearing Oil PSI** is also displayed.

If the bearing oil pressure reaches 25 psi, the *"Bearing Oil Low PSI"* will display in the alarm message area of the target screen indicating the pump is not working or a line is broken. If the bearing oil pressure reaches 250 psi indicating the filter may be plugged, the *"Bearing Oil High PSI"* will display in the alarm message area of the target screen AND the bearing pump will shut down and the cutter head rotation will stop.

Grease Pump: turns the grease pump on or off (located in the trailing section). The grease pump lubricates the bearing cavity dirt seals. The grease pump cycles automatically with the cutter head rotation. The **Grease PSI** is also displayed. If the grease pressure is less than 300 psi indicating grease is not pumping, the cutter head rotation will stop in approximately 15 minutes. If the grease pressure is over 2,500 psi indicating the grease may be plugged, the cutter head rotation will stop in approximately 15 minutes. In either case, the *"Grease Alert: Cutter will shut in 15 min."* will display in the alarm message area of the target screen.

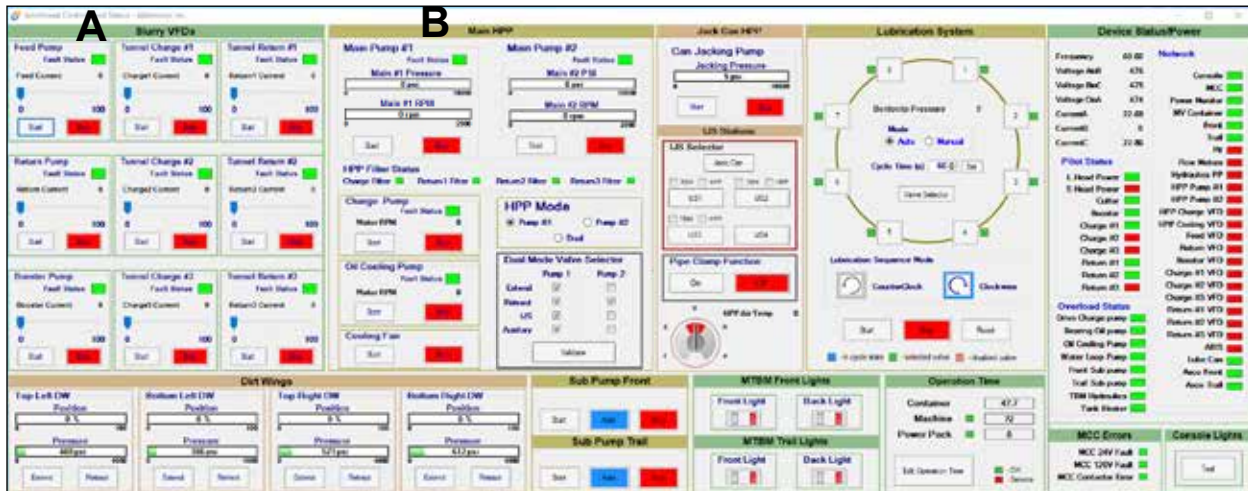
Low Grease Level: If there is no change of 25 psi in one minute, this may indicate grease pump is not pumping grease. The *"Grease Alert: Cutter will shut in 15 min."* will display in the alarm message area of the target screen. Resupply the grease pump and check pump operation.

When resupplying the grease pump, the pump must be primed: Place new grease bucket on grease container. Place pump in bucket. Prime the pump by cracking open the grease line on the pump. Turn the pump on and once grease comes out of the line, reconnect the line to the pump. Proceed as normal.

Oil Cooling Pump: controls the start and stop of the hydraulic oil cooling pump (located in the trailing section). The hydraulic oil cooling pump automatically starts when the oil temperature is at 145°F and will stop when the oil temperature is at 130°F. The hydraulic oil recirculates through the pump, heat exchanger, through the return filters and back into the hydraulic tank.

Oil Tank Heater: manually turn the oil tank (located in the trailing section) heater on as needed. The heater will remain on for one hour and then shut off. The cutter drive charge pump (from target screen) can be run with the heater to warm the pump cases for easier starting of the drive motor.

MTBM CONTROL SCREEN



The controls on the MTBM control screen can be activated with the mouse. Some of the controls on this screen are normally controlled from the control console.

SLURRY VFDS (A)

Feed Pump: displays a visual representation of the feed pump operation on or off and pump speed from 0 to 100%. The feed pump is controlled with the Above Ground Feed Pump control on the console in the control container. Fault status is also displayed; green ok, red fault. Current is displayed in amperage.

Return Pump: displays a visual button representation of the return pump operation on or off and pump speed from 0 to 100%. The return pump is controlled with the Pit Return Feed Pump control on the console in the control container. Fault status is also displayed; green ok, red fault. Current is displayed in amperage.

Booster Pump: displays a visual button representation of the booster pump operation on or off and pump speed from 0 to 100%. The booster pump is controlled with the Booster Pump control on the console in the control container. Fault status is also displayed; green ok, red fault. Current is displayed in amperage.

Tunnel (Feed) Charge #1, 2 & 3 Pumps: displays a visual button representation of the tunnel feed charge pumps operation on or off and pump speed from 0 to 100%. The charge pumps are controlled with the Tunnel Charge Pump controls on the console in the control container. Fault status is also displayed; green ok, red fault. Current is displayed in amperage.

Tunnel Return #1, 2 & 3 Pumps: displays a visual button representation of the tunnel return pumps operation on or off and pump speed from 0 to 100%. The return pumps are controlled with the Tunnel Return Pump controls on the console in the control container. Fault status is also displayed; green ok, red fault. Current is displayed in amperage.

MAIN HPP (B)

Main Pump #1 & 2: controls the start and stop of the main hydraulic pumps in the hydraulic power pack container for the jacking system. Displays the pressure and RPM.

HPP Filter Status: displays a visual indicator of the condition of the filters (charge and return filters). Green - filter ok; Red - filter is plugged must be changed. Displays the pressure and RPM.

Charge Pump: controls the start and stop of the charge pump. The charge pump automatically starts and stops with the main hydraulic pump.

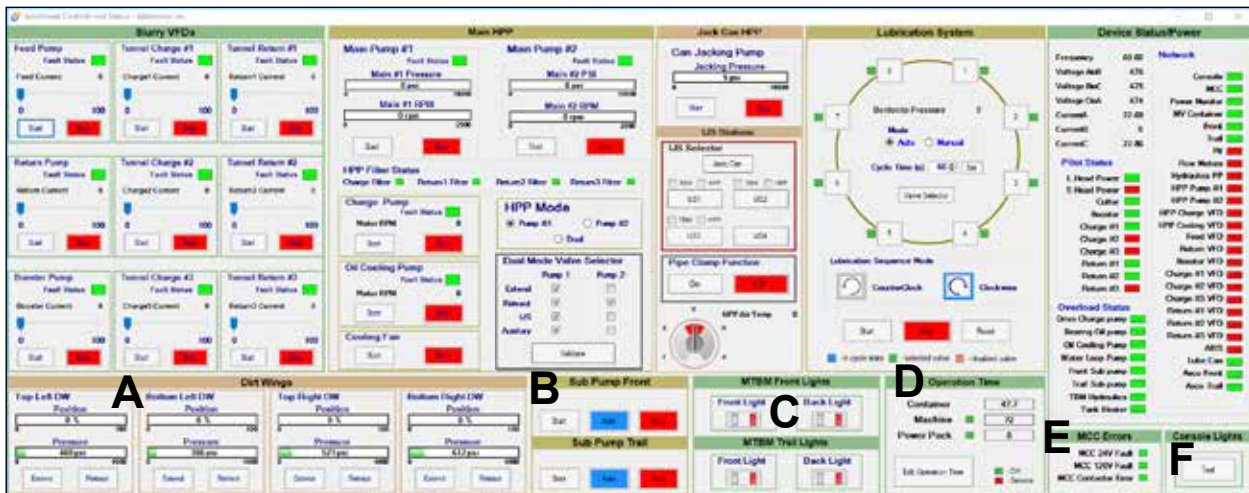
Oil Cooling Pump: controls the start and stop of the oil cooler recirculating hydraulic pump. The oil is recirculated from oil cooler back to tank. The oil cooler recirculating pump will automatically start and stop per setting on tank temperature control (low temp dial, high temp dial).

Cooling Fan: controls the start and stop of the cooling fan in the hydraulic power pack.

HPP Mode: select Pump 1 or 2 or Dual. In Dual mode, typically Pump 2 will be used for Retract only.

Dual Mode Valve Selector: in Dual mode, select the functions for each pump: Extend, Retract, IJS and Auxiliary. Typically in Dual mode, Pump 2 is used for Retract only. Once selected, click Validate.

(continued on next page)



DIRT WINGS (A)

Controls the Extend and Retract of the dirt wing cylinders. The cylinder position is shown from 0 to 100% and dirt wing pressure is displayed.

SUBMERSION PUMPS (B)

Sub Pump Front & Trail: controls the start, auto, and stop modes of the submersion pumps located in the front and trailing sections. Press Start button to run the submersion pump continuously. Press Stop button to stop the pump. Press Auto button to allow the pump to be controlled by the water level float switch of the pump. The Auto mode is the default position.

The “Front High Water” or “Trail High Water” alarm message will display, indicating water has reached the water level switch. The submersion pump will be turned on.

MTBM LIGHTS (C)

MTBM Front Lights & MTBM Trail Lights: controls the lights in the MTBM front section and trailing section.

OPERATION TIME (D)

Displays the operation time of the control container, MTBM and the Hydraulic Power Pack. The service indication is also displayed.



To reset values, click Edit Operation Time. Once complete, click Exit.

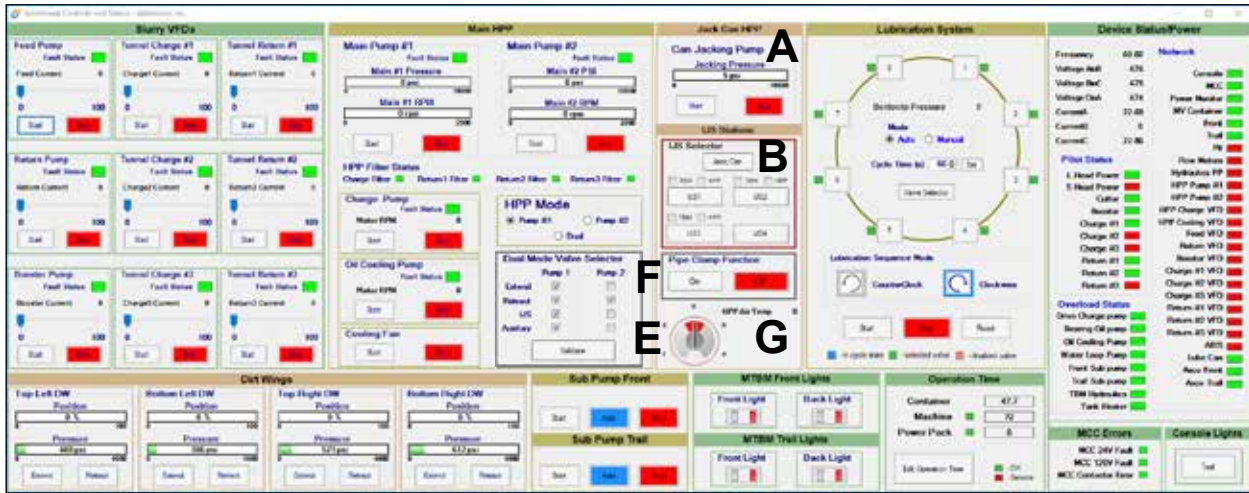
MCC ERRORS (E)

Displays if MCC is ok (green) or fault/error (red) in VFD container.

CONSOLE LIGHTS (F)

Click Test to check the operation of the console lights.

(continued on next page)



JACK CAN HPP (A)

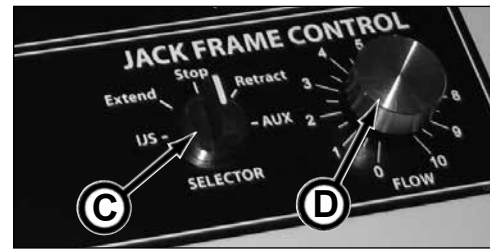
Can Jacking Pump: controls the start and stop of the jacking pump in the jacking & lubrication can. Displays the extension pressure of the jacking can thrust cylinders. The maximum jacking pressure is 8,000 psi.

IJS STATIONS (B)

IJS Selector: This window becomes active (green box) when the Jack Frame Control Selector (C) on the control console is at the IJS position.

Click the desired IJS selection; Jack Can, IJS1, IJS2, IJS3 and/or IJS4. Use flow control (D) to regulate the hydraulic flow to the jacking can thrust cylinders or the IJS stations.

- The **Jack Can** selection is the jacking thrust cylinders in the jacking can and the power source is from the jack can.
- **IJS1, IJS2,** and **IJS3** are the IJS stations in the tunnel and the power source can be either the jacking can (PD) or the hydraulic power pack (HPP).
- **IJS4** is the IJS station in the tunnel and the power source is the hydraulic power pack (HPP).



JACK FRAME CONTROL (E)

Visual representation of the Jack Frame Control on the console in the control container.

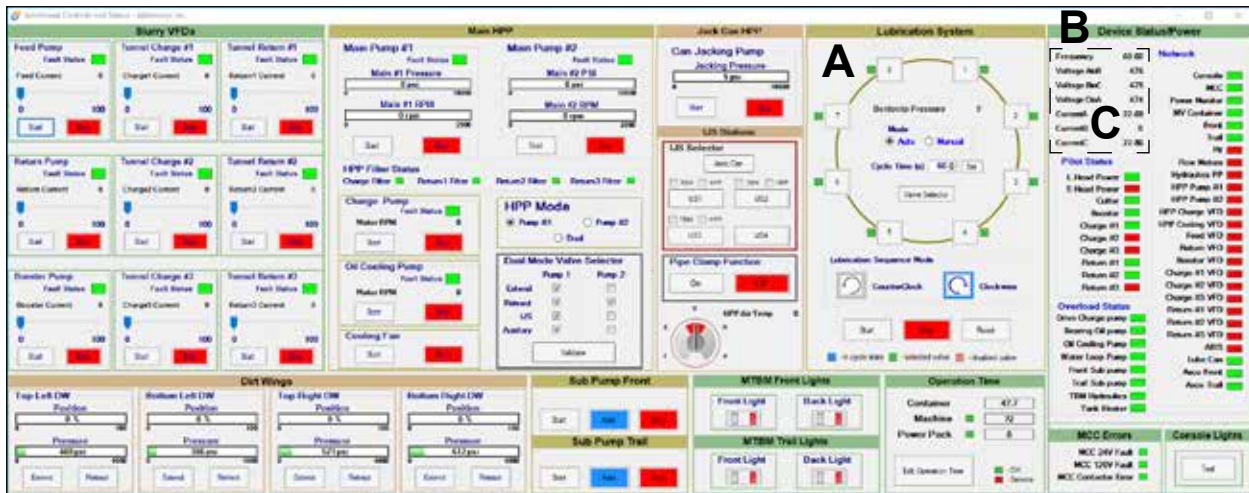
PIPE CLAMP FUNCTION (F)

Click ON to supply oil flow to the pipe clamp control valve. This will prevent pipe from springing back during a new pipe set.

HPP AIR TEMP (G)

Displays the hydraulic power pack container air temperature in degrees Fahrenheit.

(continued on next page)



LUBRICATION SYSTEM (A)

The Lubrication System display provides a visual representation of the operation of the eight lubrication valves as viewed from launch shaft into tunnel. The **Start** and **Stop** buttons control the operation of the selected valves. The **Reset** button will reset the program to the factory setting.

Bentonite PSI: displays the lubrication pressure in PSI at the lubrication manifold in the lube/jacking can. The maximum bentonite pressure is 300 psi.

Mode:

Auto mode: is the default selection. Use the Valve Selector button to select valves (see below). In auto mode the selected valves will alternate between the selected valves based on the cycle time.

Manual mode: click Manual and click on the desired lubrication valves (2 valves maximum). Click Start and the lubrication valves will cycle until the Stop button is clicked.

Cycle time (s): (for auto mode only) displays the lubrication valve cycle time in seconds. To change cycle time, click the up or down arrows to desired time and click Set button.

Valve Selector: (for auto mode only) when Auto mode is selected, click the Valve Selector button to choose the desired lubrication valves.

The **in cycle state**, **selected valve**, and **disabled valve** are represented with color coding to provide a visual representation of the lubrication valve operation.

Lubrication Sequence Mode: switch from counterclockwise to clockwise lubrication sequence.

DEVICE STATUS POWER (B)

Displays the Power Source, Pilot Status, Overload Status and Network Status.

Power Source (C): displays the external power source Frequency (Hz), Voltage and Current (amps).

Pilot Status: a green Pilot display indicates the pilot circuit is operating properly. A red Pilot display indicates the pilot circuit is not connected or is not functioning properly.

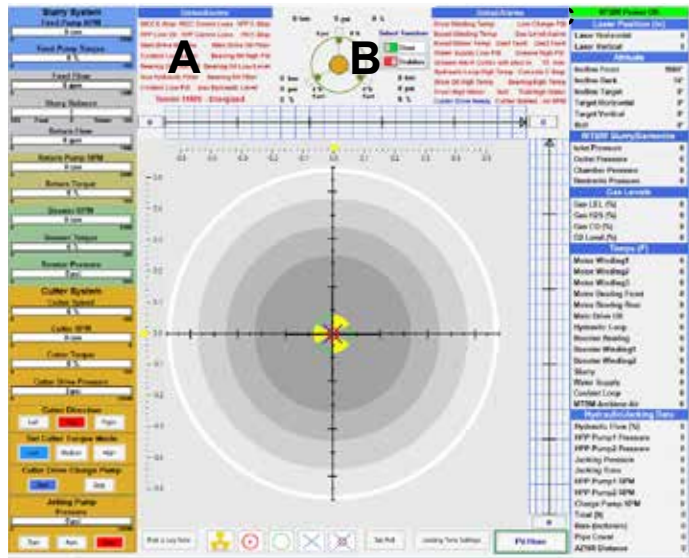
Overload Status: a green OK display indicates the pump is operating properly. A red TRIPPED display indicates the pump is not connected or has an electrical overload causing the pump breaker to trip.

Network Status: the network status window indicates when the device is Online (green) or Offline (red) with the control container controls.

ALARM MESSAGES

The target screen contains two alarm message windows to alert the operator on potential operational issues. In some cases the alarm messages are simply warnings of a potential issue that will need attention, and other alarm messages that are an immediate issue where the machine components may be automatically shut down to prevent damage or problems to the operation of the machine.

Refer to the items below and the effect to the machine:



Alarm Message Area (A)

1. Alarm Message: **MCC E-Stop**

Machine Component: VFD Container E-Stop

Effect To Machine: The message is displayed when the E-Stop in the VFD Container is activated. The cutterhead and hydraulic flow will shut down.

2. Alarm Message: **MCC Comm Loss**

Machine Component: VFD Container

Effect To Machine: The message is displayed when communication with the control container is lost. The cutterhead and hydraulic flow will shut down.

3. Alarm Message: **HPP - E-Stop**

Machine Component: Hydraulic Power Pack

Effect To Machine: The message is displayed when the E-Stop in the hydraulic power pack is activated.

4. Alarm Message: **HPP - Low Oil Level**

Machine Component: Remote Hydraulic Power Pack

Effect To Machine: The message is displayed when the hydraulic power pack oil reservoir level is low and should be filled with fresh, clean oil. Check the oil level in the hydraulic power pack.

5. Alarm Message: **HPP Comm Loss**

Machine Component: Hydraulic Power Pack

Effect To Machine: The message is displayed when communication with the control container is lost. The cutterhead and hydraulic flow will shut down.

6. Alarm Message: **Pit E-Stop**

Machine Component: Pit Box

Effect To Machine: The message is displayed when the E-Stop on the pit box is activated. The cutterhead and hydraulic flow will shut down.

7. Alarm Message: **Main Drive Oil Low**

Machine Component: Main Drive Hydraulic Oil Reservoir low oil level.

Effect To Machine: Check hydraulic reservoir oil level.

8. Alarm Message: **Main Drive Oil Filter**

Machine Component: Main Drive Hydraulic Oil System Filter is plugged.

Effect To Machine: Check filter.

9. Alarm Message: **Coolant Low Level**

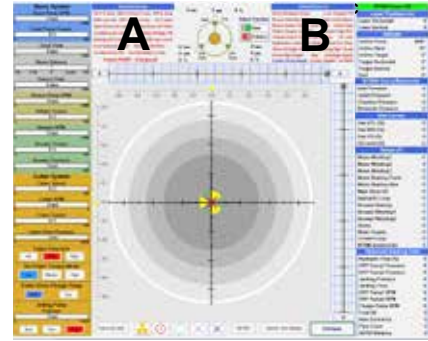
Machine Component: Propylene Glycol Reservoir

Effect To Machine: The message is displayed when the coolant level reaches the low level switch. Check coolant level.

(continued on next page)

Alarm Messages

Alarm Message Area (A) continued



10. Alarm Message: **Bearing Oil High PSI**

Machine Component: Bearing Oil Pump System

Effect To Machine: If oil pressure reaches 250 psi (default), the message is displayed indicating the bearing oil pressure is too high AND the cutter head rotation is automatically stopped. Also the bearing cavity filter may be plugged. Replace filter.

11. Alarm Message: **Bearing Oil Low PSI**

Machine Component: Bearing Oil Pump System

Effect To Machine: If oil pressure is 25 psi (default) or less, the message is displayed as a warning of low pressure, indicating the bearing pump may not be working or a line may be broken.

12. Alarm Message: **Bearing Oil Low Level**

Machine Component: Bearing Oil Cavity

Effect To Machine: Bearing oil pump and cutter head rotation will shut down.

13. Alarm Message: **Aux Hydraulic Filter**

Machine Component: Auxiliary Power Pack Filter (Front Section)

Effect To Machine: The message is displayed when auxiliary power pack filter may be plugged. Check filter.

14. Alarm Message: **Bearing Oil Filter**

Machine Component: Bearing Oil Pump System Filter is plugged.

Effect To Machine: Check filter.

15. Alarm Message: **Coolant Low PSI**

Machine Component: Propylene Glycol Cooling System

Effect To Machine: The message is displayed when coolant pressure is at 5 psi (default) or below. Check coolant system.

16. Alarm Message: **Aux Hydraulic Level**

Machine Component: Auxiliary Power Pack Reservoir (Front Section)

Effect To Machine: The message is displayed when the hydraulic oil level in the reservoir reaches the low level switch. Check reservoir oil level.

17. Alarm Message: **Tunnel 4160V - Energized**

Machine Component: Cutter Head Switch In Control Container

Effect To Machine: The message is displayed when the Cutter Head switch on the control console in the control container is ON.

Alarm Message Area (B)

18. Alarm Message: **Drive Winding Temp**

Machine Component: Main Drive Motor 500 HP Windings High Temp

Effect To Machine:

- a. The message is displayed if the main drive motor windings temperature reaches 250°F (default).
- b. If the main drive motor windings temperature reaches 300°F (default), the cutter head rotation will shut down.

19. Alarm Message: **Low Charge PSI**

Machine Component: Cutter Drive Charge Pump In Trailing Section

Effect To Machine: The message is displayed when the charge pressure for the main drive is low. The cutter head and hydraulic flow will shut down.

20. Alarm Message: **Boost Winding Temp**

Machine Component: Booster Motor

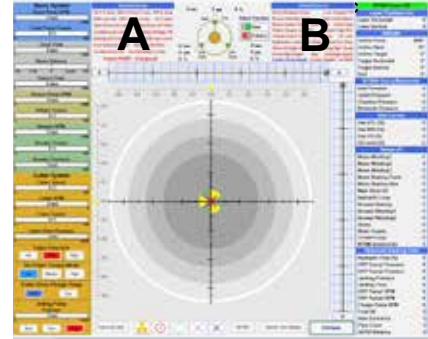
Effect To Machine:

- a. The message is displayed if the booster pump motor windings temperature reaches 250°F (default).
- b. If the booster motor windings temperature reaches 300°F (default), the cutter head rotation will shut down.

(continued on next page)

Alarm Messages

Alarm Message Area (B) continued



21. Alarm Message: **Gas Level Alarm**

Machine Component: Gas Detector: gas level is high on the LEL, H2S, CO or O2 gas detectors
 Effect To Machine: The message is displayed when the gas detector detects a high gas level reading of 10% (default) or higher for the LEL, H2S and CO gas detectors, or a low level of 19% (default) for the O2 gas detector. The horn on the pit box will sound intermittently until the system detects a gas level reading of 25% LEL, H2S or CO (default) or higher, or 23% (default) for the O2 gas detector, at which time the horn will sound continuously and the cutter head rotation and jacking frame functions will shut down.

22. Alarm Message: **Boost Motor Temp**

Machine Component: Booster Motor Bearing
 Effect To Machine: The message is displayed when the booster motor bearing temperature reaches 130°F (default). If the booster motor bearing temperature reaches 150°F (default), the cutter head rotation will shut down.

23. Alarm Message: **Gas1 Fault**

Machine Component: Gas Detector LEL & H2S
 Effect To Machine: The message is displayed when there is a malfunction with the gas detector system. Stop immediately and troubleshoot the problem before proceeding. NEVER operate microtunneling system without a proper operating gas detector and NEVER enter a tunnel without a properly functioning portable gas detector.

24. Alarm Message: **Gas2 Fault**

Machine Component: Gas Detector CO & O2
 Effect To Machine: The message is displayed when there is a malfunction with the gas detector system. Stop immediately and troubleshoot the problem before proceeding. NEVER operate microtunneling system without a proper operating gas detector and NEVER enter a tunnel without a properly functioning portable gas detector.

25. Alarm Message: **Water Supply Low PSI**

Machine Component: Water Cooling Tank (Above Ground)
 Effect To Machine: The message is displayed when the water supply pressure reaches 25 psi (default) or below. Check cooling system.

26. Alarm Message: **Water Supply High PSI**

Machine Component: Water Cooling Tank (Above Ground)
 Effect To Machine: The message is displayed when the water supply pressure reaches 150 psi (default) or above. Check cooling system.

27. Alarm Message: **Grease Low PSI**

Machine Component: Grease Pump
 Effect To Machine: The message is displayed if the grease pressure is less than 300 psi indicating grease is not pumping. The grease pump will shut down and the cutter head will shut down in 15 minutes. Check grease pump operation.

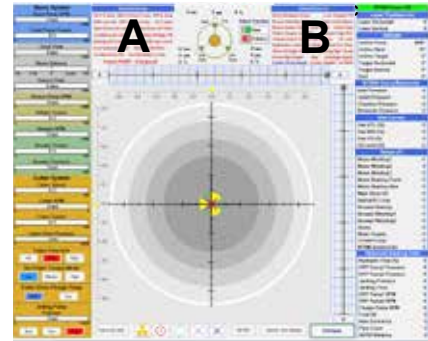
28. Alarm Message: **Grease High PSI**

Machine Component: Grease Pump
 Effect To Machine: The message is displayed if the grease pressure is over 2,500 psi indicating the grease filter may be plugged. The grease pump will shut down and the cutter head will shut down in 15 minutes. Replace grease filter.

(continued on next page)

Alarm Messages

Alarm Message Area (B) continued



29. Alarm Message: **Grease Alert: Cutter will shut in 15 min**

Machine Component: Grease Pump

Effect To Machine: The message is displayed when grease pump pressure is low (300 psi) or high (2,500 psi) or low level. The cutter head will shut down in 15 minutes. Check grease system.

30. Alarm Message: **Hydraulic Loop High Temp**

Machine Component: Main Drive Hydraulic Loop

Effect To Machine: The message is displayed when the hydraulic loop temperature reaches 160°F (default) and the cutter head will shut down when the temperature reaches 180°F (default).

31. Alarm Message: **Console E-Stop**

Machine Component: Control Container

Effect To Machine: The message is displayed when the E-Stop on the control container is activated. System is shut down.

32. Alarm Message: **Drive Oil High Temp**

Machine Component: Main Hydraulic Reservoir Tank

Effect To Machine: The message is displayed when the drive oil temperature reaches 140°F (default). If the oil temperature reaches 160°F (default), the cutterhead will shut down.

33. Alarm Message: **Bearing High Temp**

Machine Component: Main Drive Motor Bearing

Effect To Machine: The message is displayed when the bearing temperature reaches 130°F (default). If the oil temperature reaches 150°F (default), the cutterhead will shut down.

34. Alarm Message: **Front High Water**

Machine Component: Submersion Pump in Front Section

Effect To Machine: The message is displayed when the water in the front section has reached the water level switch. The submersion pump will automatically start.

35. Alarm Message: **Roll**

Machine Component: MTBM Roll

Effect To Machine: The message is displayed when the roll degree setting parameters are exceeded. The cutter head and hydraulic system will shut down.

36. Alarm Message: **Trail High Water**

Machine Component: Submersion Pump in Trailing Section

Effect To Machine: The message is displayed when the water in the trailing section has reached the water level switch. The submersion pump will automatically start.

37. Alarm Message: **Cutter Drive Ready**

Machine Component: Main Drive

Effect To Machine: The message is displayed when the cutter drive is ready to operate.

38. Alarm Message: **Cutter Stalled - no RPM**

Machine Component: Cutter Head

Effect To Machine: The message is displayed when the cutter head does not register rpm at approximately 10% speed.

MICROTUNNELING SYSTEM SOFTWARE PROGRAMS

There are software programs that are used to control and monitor all aspects of the microtunneling system operation. Below is a summary of the microtunneling system software programs.

Machine Select

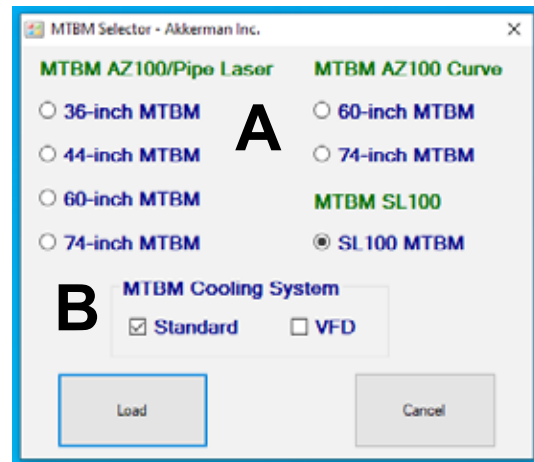


The Machine Select program loads the specific MTBM head factory set constant data values for use in the Akkerman microtunneling system software programs.

After computer start-up, double click the MTBM Select icon on the desktop and then select the MTBM head size (A) for the current project, select Cooling System (B) (if applicable, see below) and click OK. The values loaded from this program are the characteristics of the machine make-up and design. If the constant values are changed or the wrong head size is selected, erroneous data will be calculated, resulting in improper monitoring of the MTBM position.

Select the MTBM cooling system for the project:

- Standard - using FA10030F Water Cooling Tank
- VFD - using FA10178F 1685 Water Cooling Tank

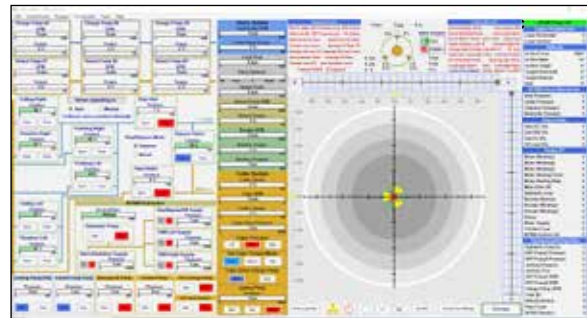


Target Screen Program

The target screen program shows all critical tunneling data.

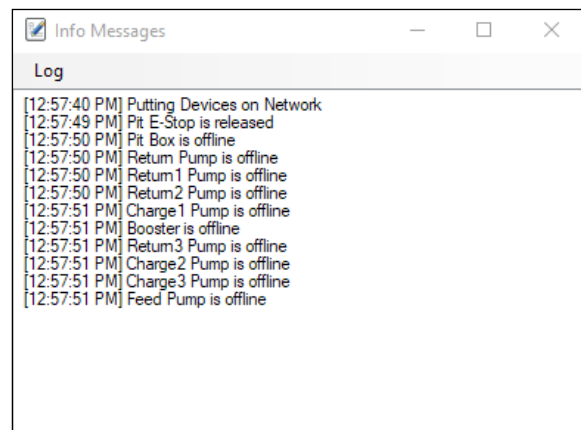
This program automatically loads once the Machine Select program is activated.

Refer to Target Screen in this manual for more information.



Log Messages

Once the target screen is activated, the Log Messages screen automatically appears on the monitor and displays non-critical, informative messages of the system operation.



(continued on next page)

Additional Controls & Status Screen Program

The additional controls & status screen program shows the slurry system, cutter system, MTBM hydraulics, stabilizers, Jacking Hydraulics, overloads and network status controls.



This program automatically loads once the Machine Select and Target Screen programs are activated. This program can also be accessed from the Target Screen by clicking Control Forms on the menu bar and clicking Additional Controls from the pull down menu.

Refer to MTBM Control Screen in this manual for more information.

Camera Program

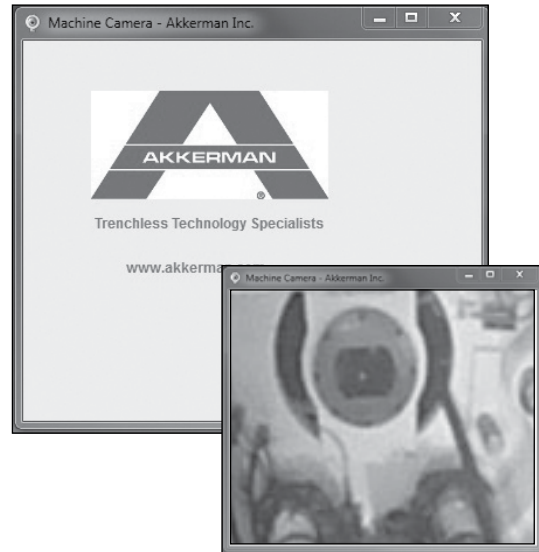
A camera is installed on the inside of the front and trailing sections of the MTBM for viewing the target, booster pump, hydrostatic drive pumps, etc. The program allows the operator to set camera settings to specific components.

Double click the MTBM_1 or MTBM_2 camera icon to display the camera window.



NOTICE

When the camera program is booted up and the boring head ethernet cable is not connected to the MTBM control box, a window with the Akkerman logo will be visible (as shown). Once the communication is connected between the MTBM and the control container, the video feed of the MTBM front section will be visible in the camera window.



The screen image can be resized by dragging a corner of the window to the desired size.

Refer to MTBM Camera in the Microtunneling System Periphery Drive Operator’s Manual (050132A) for more information.

An optional pit or launch shaft video camera setup with monitor is available with two to four cameras. Contact your Akkerman Aftermarket Support representative for more information.

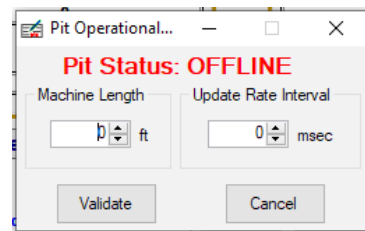
Pit Operational Variable Data Editor

This program editor provides the value to calculate the pipe advance rate.



The program icon is located on the desktop.

For more information, refer to Supplementary Editor Programs, 3. Misc Editor in section 6, Operation in the Microtunneling System Periphery Drive Operator’s Manual (050132A).



(continued on next page)



MTBM Operational Data Editor

This program editor is used to calculate the position of the cutting head during the tunneling operation. Most of the fields contain constant values and should not be changed since they are the design specifications of the MTBM.

This editor also provides a method to calibrate the steering cylinders, stop valve, bypass valve, and the cutting valve.

The program icon is available on the desktop or the program can also be accessed from the Target Screen by clicking Programs on the menu bar and clicking Machine Editor from the pull down menu.

For more information, refer to Supplementary Editor Programs, 1. MTBM Front Editor in section 6, Operation in the Microtunneling System Periphery Drive Operator’s Manual (050132A).

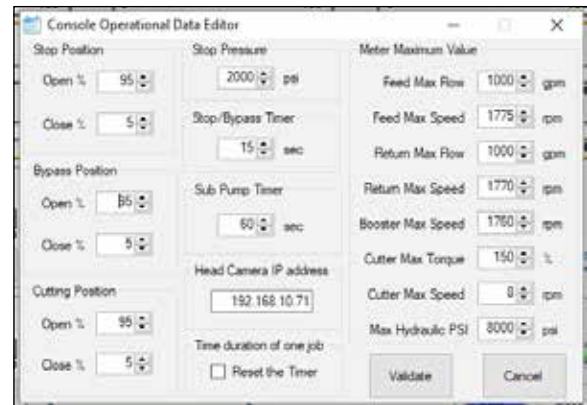


Console Operational Data Editor

This program editor allows the operator to change the console dynamic variable ranges and meter values. The meter values are visible on the target screen.

The program icon is located on the desktop or the program can also be accessed from the Target Screen by clicking Programs on the menu bar and clicking Console Editor from the pull down menu.

For more information, refer to Supplementary Editor Programs, 2. Console Editor in section 6, Operation in the Microtunneling System Periphery Drive Operator’s Manual (050132A).



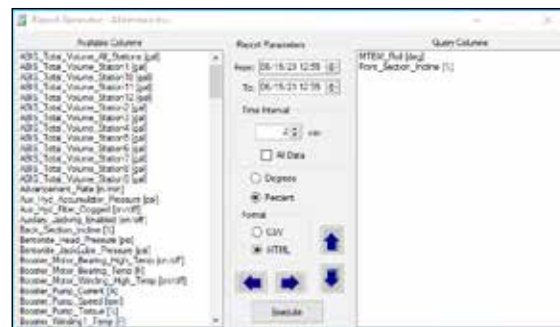
Report Generator

A report generator program icon is available on the desktop for creating reports of data variables collected during operation.

This program can also be accessed from the Target Screen by clicking Programs on the menu bar and clicking Report Generator from the pull down menu.

For more information, refer to Using The Report Generator in section 6, Operation in the Microtunneling System Periphery Drive Operator’s Manual (050132A).

(continued on next page)





Speed Knob Settings Program

The Speed Knob Settings program is used to change the sensitivity of the flow controls on the console of the control container.

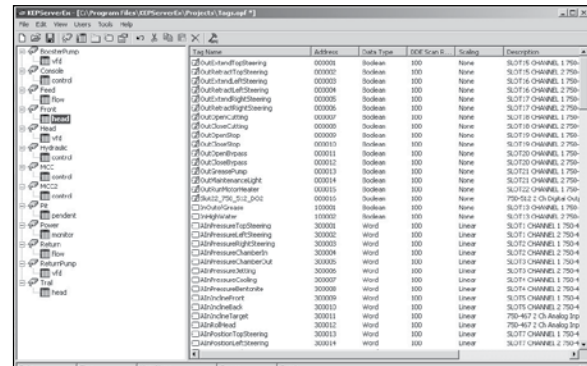
Access this program from the Target Screen by selecting Programs from menu, and clicking VFD Config Editor from the pull down menu.



KEPServerEX5 Configuration

The KEPServerEX5 Configuration is a program (automatically loads and runs in the background when the Target screen is loaded) that communicates the MTBM input and output device component data to and from the operator in the control container via the Target screen and MTBM control screens.

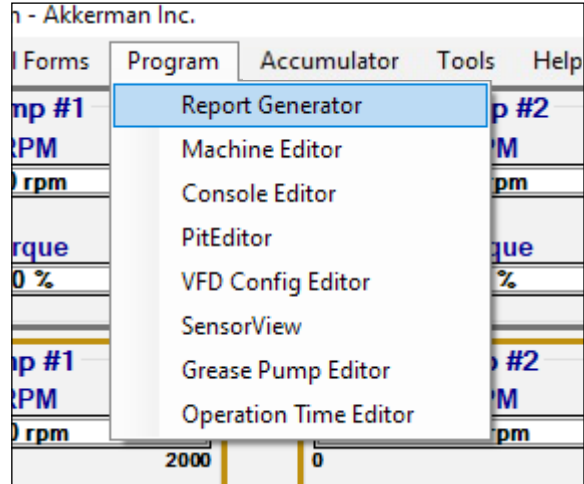
This program is also used to calibrate linear transducers (stop valve, bypass valve, steering cylinders, stabilizer cutting nozzles valves and dirt wings) when the components are repaired or replaced.



For more information, refer to section 6, Linear Transducer Calibration - Slurry Valves & Steering Cylinders and Linear Transducer Calibration - Dirt Wings in section 6, Operation in the Microtunneling System Periphery Drive Operator’s Manual (050132A).

PROGRAM MENU

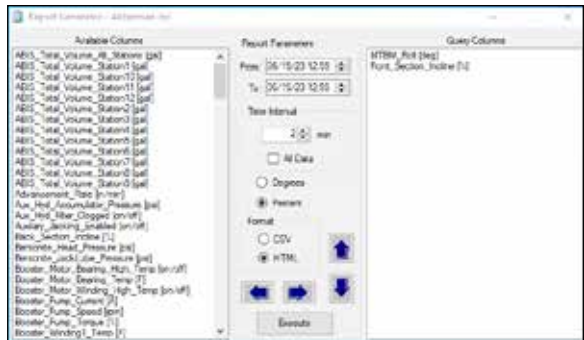
Access the following programs with the Program menu from the left portion of the Target Screen. In addition, most of these programs have a program icon located on the desktop.



• **Report Generator**

This program is used for creating reports of data variables collected during operation.

The program icon is also located on the desktop.



• **Machine Editor** (Front Editor)

This program editor is used to calculate the position of the cutting head during the tunneling operation. Most of the fields contain constant values and should not be changed since they are the design specifications of the MTBM.

This editor also provides a method to calibrate the steering cylinders, stop valve, bypass valve, cutting valve and dirt wings.

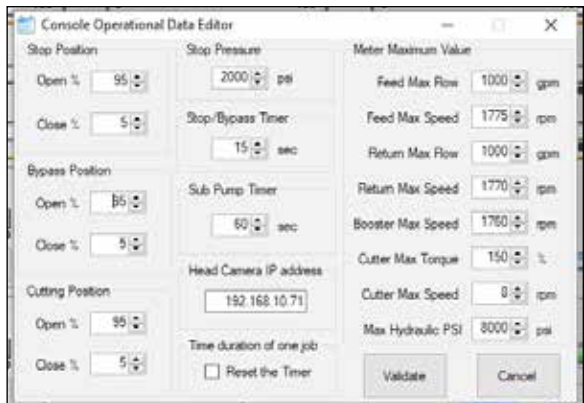
The program icon is also located on the desktop.



• **Console Editor**

This program editor allows the operator to change the console dynamic variable ranges and meter values. The meter values are visible on the target screen.

The program icon is also located on the desktop.

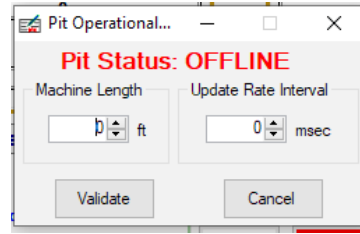


(continued on next page)

• **PitEditor**

This program editor provides the value to calculate the pipe advance rate.

The program icon is also located on the desktop.



• **VFD Config Editor**

This program editor is used to change the sensitivity of the flow controls on the console of the control container.

The program icon is also located on the desktop.



• **SensorView**

This program displays the status of every I/O (Input/Output). This is used for troubleshooting only. Contact your Aftermarket Support representative for more information.



• **Grease Pump Editor**

This editor is for future use for adjusting the grease pump operating cycle.

• **Operation Time Editor**

This program editor is used to reset the operation time and service alarms.



CONTROL FORMS MENU

Use the Control Forms menu from the left portion of the target screen to arrange the MTBM control screen, Additional Controls, to the front for access.

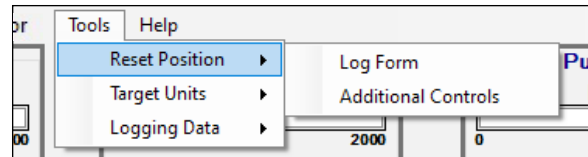


TOOLS MENU

Access the Tools menu from the left portion of the Target Screen.

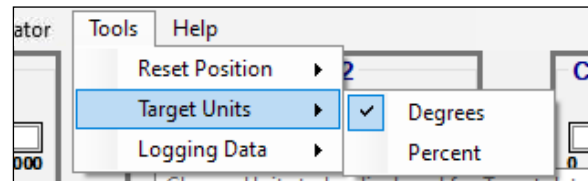
Use the Tools menu to:

- **Reset Position:** if the Log Messages window or Additional Controls window becomes missing from the computer screen, select Reset Position and the windows will reappear in the default position.

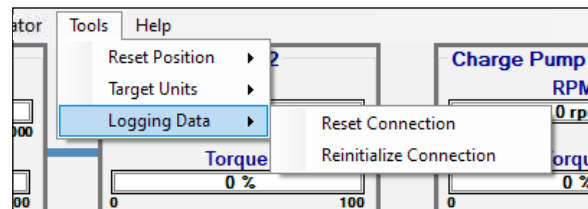


If the operator minimizes the windows and close the program, the windows may open outside the scope of the screen.

- **Target Units:** allows the operator to select between Degrees or Percent on the MTBM operational Attitude meter information.



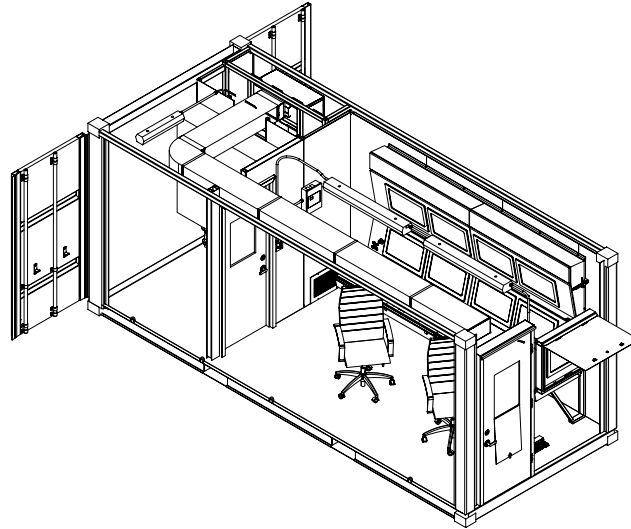
- **Logging Data:** this tool is used if there is a problem with the database. Contact your Aftermarket Support representative before using.



Specifications

CONTROL CONTAINER - SN FA22242F

The Control Container houses the operator's control console and bulkhead panel for electrical and communication connections. The operator monitors and controls all aspects of the tunneling operations (MTBM functions, jacking thrust frame, slurry flows, slurry sequencing, monitoring, IJS, bentonite injection, high pressure jetting etc.) through a multi-monitor display using Akkerman proprietary software and data logging system. An optional camera setup to display video on control room monitors, such as the MTBM head, separation plant, launch shaft and/or job site is available.

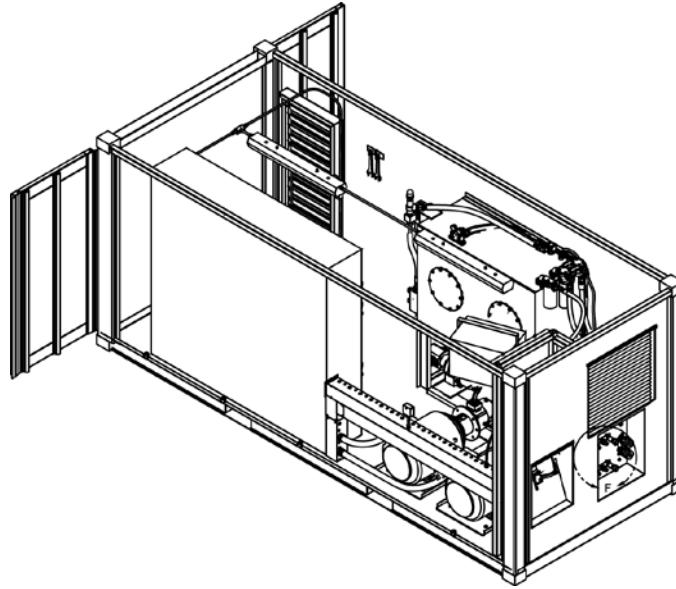


Operator Container:

- Container 20' L x 8' W x 8' H
- Weight 9,500 lbs
- Double Doors for access to electrical bulkhead and storage cabinet area
- 30 inch personal access door to operator console
- Redundant Ethernet Link to VFD Container
- 2 4 foot Dimmable LED Lights in operator area
- 1 2 foot LED light in storage area
- 60 Amp 220VAC Electrical Feed from VFD container Panel Board
- Small Breaker panel for local power distribution
- 1 ton AC unit with 12k BTU heat 220VAC 30 Amp
- 2 63 inch wide consoles
- 2 Consoles computers with 4 24 inch monitors each
- 1 external 24 inch monitor mirror of target screen for inspector viewing
- Lockable vandal guard for external monitor

HYDRAULIC CONTAINER - SN FA2243F

The Hydraulic Container provides hydraulic oil for the jacking frame and microtunneling auxiliary functions (IJS stations).



Container 20' L x 8' W x 8' 6" H

Weight 21,500 lbs

Jacking 1: 100 HP, 0-30 GPM x 8,000 PSI

Jacking 2: 100 HP, 0-30 GPM x 8,000 PSI

Cooling: 30 GPM

Charge Pump: 90 GPM

Electrical: 480VAC 3 Phase, 300A Main

Hydraulic Oil Reservoir: 330 Gallon

Two High Flow Return Connections

Ethernet Connection for Control Container Communication

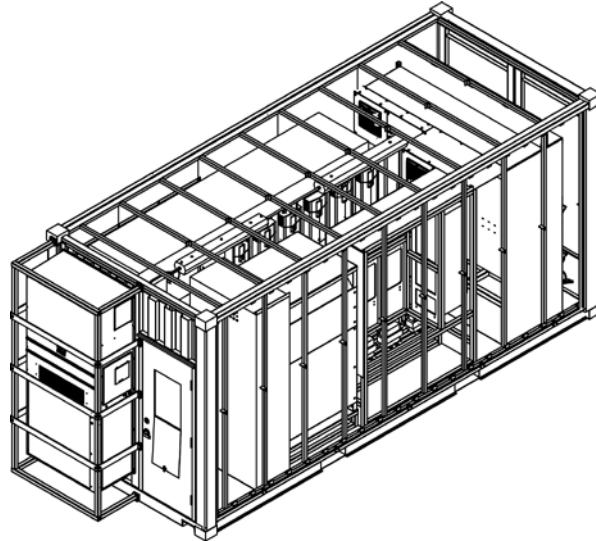
Forced Air Hydraulic Cooler

Automatic Fresh Air Louvers

Two 4- Foot LED Lights

VFD CONTAINER - SN FA2241F

The VFD Container is equipped with ten variable frequency drives (VFDs) to efficiently operate the electric motors for the main MTBM drive, slurry feed, slurry booster and slurry return systems. The motors are operated from the control container, control console controls.



Container 20' L x 8' W x 9' H x 8'6"

Weight 25,000 lbs

Double Doors for access to electrical bulkhead
Personal access door to internal electrical equipment

24 Port PoE Ethernet Switch

Redundant Ethernet Link to Control Container

2 4 foot LED Lights

480VAC half

-4 Section MCC

-1000 Amp 480VAC Main Breaker

-480VAC to 220VAC 1PH transformer 25kVA

-6 ton AC unit with 30k BTU heat 480VAC 30 Amp

-6 100 HP Slurry Pump VFDs

-Line Filters on all VFDs

-Load dv/dt filters on all 480VAC VFDs

for cable lengths up to 1,300 feet

575VAC half

-2 Section MCC

-1000 Amp 480VAC Main Breaker

-480VAC to 575VAC 3PH transformer 770kVA

-1 250HP Cutter Head VFD

-3 100HP Slurry Pump VFDs

-Line Filters on all VFDs

-Load Sine Wave Filters on all 575VAC VFD to
support long cable lengths up to 5,000 feet

NOTES

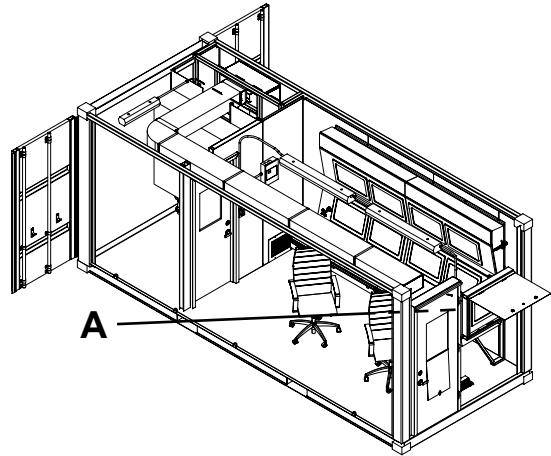
Identification Numbers

Model and serial numbers are required when ordering parts or requesting service information. Record your model and serial numbers below.

CONTROL CONTAINER (A)

Model Number _____

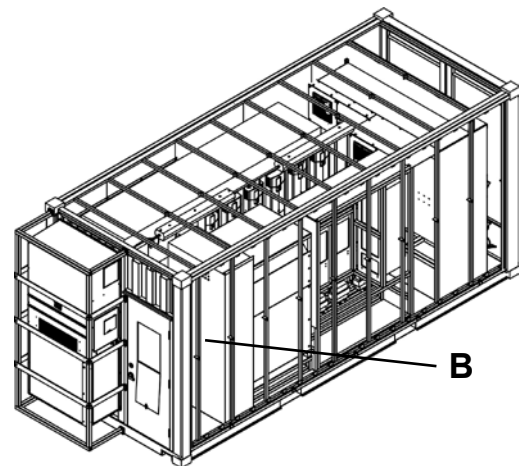
Serial Number _____



VFD CONTAINER (B)

Model Number _____

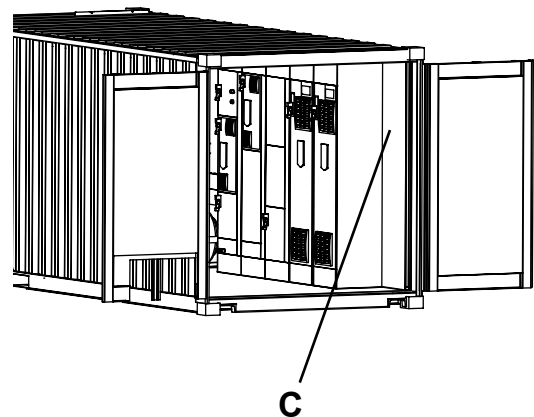
Serial Number _____



HYDRAULIC CONTAINER (C)

Model Number _____

Serial Number _____



NOTES

Safety Data Sheets

The Federal Occupational, Safety, and Health Administration (OSHA) Standard 29 CFR 1910.1200, require that specific safety data sheets (SDS) be available to employees before operating this equipment. This may include information on substances contained in this equipment such as hydraulic fluid and gear lubricant.

Akkerman Inc. will provide, at no cost, SDS which apply to its product line. Simply contact your Akkerman Product Support representative for a copy.

To ensure a prompt response to your SDS request, include your return address (including zip or postal code) and the equipment's model numbers and serial numbers with your request.

NOTES

Warranty

Akkerman warrants that all equipment manufactured by it be free from defects due to workmanship or material when normally used and serviced for a period of 90 days from the date of shipment by Akkerman. Normal wear and tear to the equipment, including, but not limited to, wear on the cutter face tooling, hydraulic filters, augers, casings, slurry line and seals is not covered by this warranty. Akkerman does not warrant that the equipment meets the requirements of any particular safety code or rule governing equipment classification. If the Customer has questions about local safety codes, rules or ordinances, authorities local to the project should be consulted.

In order to be considered as a potential warranty claim, the component in question must be returned to Akkerman (freight prepaid) for factory inspection and analysis, and determination of warranty applicability. No warranty is provided for electronics or electrical components of any kind. The validity of all warranty claims are subject to the discretion and determination of the Akkerman Aftermarket Support Department. All such determinations are final.

Warranty

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