SALES AIDS

AUTO-CARTS

Issue Date:
September 2008 Rev 00

AGC SALES AIDS MANUAL

INTRODUCTION...

THE INFORMATION PRESENTED IN THIS MANUAL IS INTENDED TO PROVIDE A BASIC KNOWLEDGE OF A CLASS OF AUTOMATIC VEHICLE KNOWN AS AGC (AUTOMATIC GUIDED CART). THIS TECHNOLOGY IS BECOMING A MAJOR PART OF CURRENT AND FUTURE PLANNING FOR SOME COMPANIES.

CURRENTLY, THIS IS THE MOST ADVANCED PRODUCT IN IT'S CLASS. THIS EXPOSURE TODAY WILL PUT THE "HOTTEST" MATERIAL HANDLING PRODUCT ON THE FLOORS OF THE SHAKERS AND MOVERS OF INDUSTRY. THE AGC IS APPLICABLE IN BOTH VERTICAL AND HORIZONTAL MARKETS.

A BASIC UNDERSTANDING OF CONVENTIONAL CONVEYOR TECHNOLOGY (POWER & FREE, PALLET CONVEYOR, AGV, ETC.) IS DESIRABLE. BECAUSE THIS IS A NEW APPROACH TO SOME CLASSIC MATERIAL HANDLING SITUATIONS, THE SALES EFFORT USUALLY REQUIRES A CERTAIN AMOUNT OF CUSTOMER EDUCATION. THE INFORMATION IN THIS MANUAL WILL ASSIST YOU IN THAT EFFORT.

CONTINUED PRODUCT DEVELOPMENT BEGINS WITH IMAGINATION AND INNOVATION. IF A SPECIAL CUSTOMER NEED IS IDENTIFIED, OR, THERE ARE IMPROVEMENTS WHICH CAN BE MADE IN THE AGC PRODUCT, PLEASE CONTACT THE FACTORY AND SHARE THE IDEAS. THE NEXT INNOVATION ENABLES THE 3D/IDC/AUTOCRAFT AGC PRODUCT TO STAY A STEP OR TWO AHEAD OF THE COMPETITION.

INNOVATION and IMAGINATION IS THE ANSWER

AGC SALES AIDS

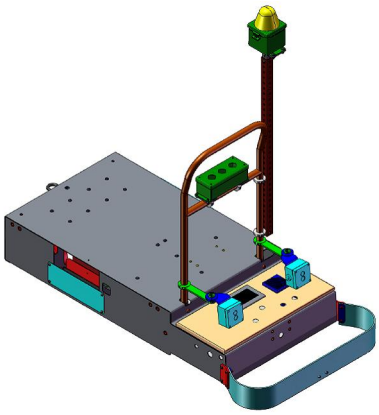
Issue Date: September 2009 Rev 00

INNOVATION and IMAGINATION IS THE ANSWER

3-D SALES
604 Smith Street, Algonac, MI 48001
Certified MBE; Phone: (810) 765-8160
www.threedsales.com

AUTOCRAFT TOOL & DIE CO.
2026 South Parker, Marine City, MI 48039
ISO 9001 Certified; Phone: (810) 765-1333
www.auto-craft.com

WHAT IS AN AUTO-CART AGC?



AN AUTOMATIC GUIDED CART (AGC) ISé

- It is a battery powered vehicle similar to an AGV but more closely related to a mobile robot.
- It is a flexible accumulation ñconveyoròon wheels.
- A tunnel, tugger or unit load configuration can be accommodated with the same vehicle with add-on options or modifications.
- It has ñtonsòof capacity.
- With a little care, it will not complain or take a vacation
- It is revolutionary because it uses a state-of-the-art optical guidance system.
- It uses an economical commercially available guide path tape or paint or tape over magnetic tape.
- The guide path can be modified in ñminutesò
- It uses mass-produced, commercially available components, where applicable.
- It is compact, powerful, robust and simple.
- It is programmable and configurable in its base configuration.
- All you need to setup the AGC is on-board.
- It will automatically slow down for corners and speed up when clear of the corner without extra floor controls.
- It can operate in a solitary or fleet environment.
- It can be point-to-point or route driven.
- It can be stand-alone or put on a stand-alone WIFI network.
- It is the most economical AGC solution available.
- There are FREE software upgrades.
- An AGC is INNOVATION and IMAGINATION.

09-17-2008

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AUTOCRAFT TOOL & DIE

AUTO-CART (AGC) - QUESTIONNAIRE

Customer and Application Survey – 07/07

(For use with: E-CART, TUGGER & TUNNEL Carts)

Date: Proposal #: 3D-Q Proposal Due: Salesperson:

Contact Name: Phone: ( ) - Cell: ( ) -

Customer: E-mail: Plant:

Address: City: State: Zip:

Budget Price: Y N Firm Price: Y N Budget: $

Order Date: / / Start-up Date: / /

AUTO-CART Model:

Light Duty (E-500) Type - Deck Tugger Tunnel Optical Magnetic
Med. Duty (E-3500) Type - Deck Tugger Tunnel Optical Magnetic

PRODUCT TO BE HANDLED DESCRIPTION:

Product Type: Carton Pallet Tote Ropak Fixture Trailer Flow Rack Conveyor Unit Loads Other:

Length: **Width:** **Height:** **Weight: (min)** **(max)**

Load Characteristics (Wt. Dist.; CG, Stability, etc.):

Loaded With: Fork Truck: Y N (FT Barrier required) Conveyor: Y N Manual: Y N Robot: Y N

Comments:

PRODUCTION RATE:

Jobs per hour (JPH): Takt Time: sec. to sec. Travel Time Sta. to Sta.: sec.

Indexing: Y N Continuous Flow: Y N Transportation: Y N From/To: Y N

Job C/C (Ft): Synchronous Speed: Y N Operator(s): Right: Y N Left: Y N Both Sides: Y N

Stop Codes: Index Carts At Once: Y N Start/Stop Cart Manually: Y N Start on Timeout: Y N

Start after ALL PBs Pushed: Y N Remote Start: Y N Precision Stopping: Y N ±¼ ±½ ±¾

Stop Station on a curve: Y N

Comments:

FLEXIBLE BUMPERS:

The flexible bumper should be 2ò to 4ò wider than the AGC width. If the product/trailer is to be protected, then, the flexible bumper should be wider than the product. Standard bumper width is ~28ò If the product/trailer is wider than the slave carrier or mule, increase carrier width or add side protection. Bumper depth will be determined by speed, weight of mule, slave carrier and live load.

Side Protection Required (Bumper): Y N **Parallel Side Protection:** Y N

CONTACT THE FACTORY IF IN DOUBT!!!

Contact the customers Safety Group for information on clearance cart-to-cart and fixed obstacle. We recommend 18ò to 20ò minimum clearance.

CUSTOMER MUST AUTHORIZE CLEARANCES LESS THAN 18" TO OBSTRUCTIONS OR OTHER VEHICLES!!

BLOCKING, ACCUMULATION AND TRAFFIC CONTROL:

Standard Ultrasonic(s) and Bumper Optic Sensor are **NOT SAFETY RATED**. **Safety Rating Required:** Y N

Non-Safety Rated Laser and Optics are available. ADD: Y N **Safety Rated Laser optics to be added. ADD:** Y N

Safety Rated Laser Optic Options: SICK S300: Y N STI Obstacle Sensor: Y N LEUZE Lumiflex ROTOSCAN RS4-4: Y N

Accumulation: By Floor Marker Plate**:** Y N Manual (AGC PB): Y N Flexible Bumper / Ultra-sonic: Y N By STEP: Y N

Does the layout have multiple guidepath entrance and exit areas (merges and diverges / spurs / sidings)? Y N

Are there Traffic Management Control required (Upper level PLC)?

CONTROLS:

Cart Controls:

STEP Programming: Y N Floor Marker Plates (Standard): Y N STEP Type: Y N Plate Anchors: Y N Mounting Tape: Y N

2nd Proximity Sensor for Floor Control: Y N

Additional Cart Controls:

2nd E-Stop: Y N 2nd Release PB: Y N Combo E-Stop and Release PB Box: Y N Transmit/Receive PE, 24VDC: Y N

Product Present Sensors:

Proximity Sensor (1): Y N Proximity Sensor (2): Y N Photo-Eye & Reflector (1): Y N

Communications:

Master Cart Control Panel (MCCP) w/HMI Required: Y N Communications w/Plant Host: Y N Ethernet (2.4 GHZ): Y N

Radio (Requires STEP): PLC-to-Cart Y N Radio: Cart-to-Cart Y N Radio Survey: by Customer Y N by IDC Y N

Recommend IDC Stand-Alone Wireless System: Y N Plant Wireless System: Y N

Interlocks to Other Control Systems: Y N If so, how many?

AGC MULE and SLAVE CART/TRAILER:

Towing/Unit Load: Trailer wt: Total wt of loads on (1) trailer: Total wt pulled on ALL Trailers:

Total wt of loads on Unit Load: Customer Supplied Deck: Y N Customer Supplied Fixtures: Y N

Wt of Customer supplied deck/fixture: Customizations:

SLAVE/CARRIER FRAME:

Width: Length: Working Height from Floor: Est. Wt: Est. CG:

Total wt of loads on Slave Cart: Wt of Integrator added Customizations: Load Guides Required: Y N

Fork Pockets: Y N Stanchions, Brake and Trunnion: Y N Outrigger Casters (for 3-Whl Mules): Y N

Bullet Towing Pin: Y N Push Handles (Loop Style w/Light): Y N Ht of Light Mast: Patlite w/Sound Module: Y N

Paint Color: Grey Safety Orange Safety Yellow ***Grey is standard. There is an additional charge for special colors.***

OPERATOR INTERFACES:

PB Enclosure is required for the AGC to operate (included in Towing/Unit Load/Tunnel Models).

Is Rear PB Enclosure (E-Stop/Release) required? Y N

Determine how many additional inputs and outputs are required? Does cart controller have adequate I/O: Inputs Outputs

Interfaces with other equipment (robots, conveyor, call boxes, push buttons, routing assignments, etc.): Y N What?

FACILITY CONDITIONS:

Floor Condition: Painted Stickers/Label Dry Colors on Floor Dust Dirt/Debris Water Oil Slippery/Shiny

Step Ht.: Max 5mm, Y N Void Width: Max 10mm, Y N Floor Slope: Max 3ôin 100ô Y N Surface Roughness: Max 10mm, Y N

Ambient Temperature: °F If a Laser is requested, are there: Dock Doors Y N Personnel Doors Y N Windows Y N

FACILITY LAYOUT and AUTO-CART GUIDEPATH:

Are there any potential clearance problem areas?

Where do AGCs interface with operators, equipment, aisles, robots or building (i.e. doors, vertical lifts, etc.)?

Are these functions required? Speed Changes: Y N Precision Stopping: Y N Stop-and-Go w/Timer Delay: Y N

Aisle Crossings: Y N w/Lights: Y N Status Lights @ Workstations: Y N Cart Present Interlocks w/Off Line Equip.: Y N

Guidepath: Will they cross? Y N Cross at what angle? ° Are there radius limitations? Y N Ó180°: Y N Ó90°: Y N

DUTY CYCLE & BATTERY CHARGING:

Hours per Shift: Shifts per Day: Hours per Day: Days per Week:

Time between Shifts: Length of Lunch Break: Length of Break: # of Breaks per Shift:

Charge Method (circle one): Manual On-Board: Y N Manual Off-Board: Y N Automatic: Y N Opportunity: Y N

Removable Battery Pack: Y N Charger size (circle one): 25-amp: Y N 40-amp: Y N Charger/Battery Pack Caddy: Y N

Batteries: GEL (Standard): Y N AGM (Absorbed Glass Mat): Y N Wet (AC Delco S2000): Y N

WORKSTATION SEQUENCE OF OPERATION (Attach Description):

Example: Load/Unload ï AUTO-CART AGC enters the station and stops automatically. Full totes are manually unloaded from the AUTO-CART. Empty totes are manually loaded on AUTO-CART. Operators push a button on the AUTO-CART for it to continue.

MISCELLANEOUS:

2ò Orange Tape: FT. 3ò Clear Cover Tape: FT. Manual Tape Applicator: Y N Orange Epoxy Paint: Y N

Standard Product Application Questions (“Yes” Could mean custom product)

1. Are there components or services required that are not on the pricing guide?
2. Does the system require Autocraft/IDC design responsibility for the system?
3. Does the system require Autocraft/IDC design responsibility for AGC or system electrical controls?
4. Does the System require any of the following?
   - Y N Reverse direction
   - Y N ñCrabò Sideways
   - Y N Travel on anything other than clean smooth hard floor surface.
   - Y N Traverse ramps or grades
   - Y N Traveling through an oven or paint booth.
   - Y N Wash down, sterilization, or outdoor running.
   - Y N Compliance with ñextensiveò specifications.
   - Y N Functionality not in the product specifications.

AUTO-CART CONFIDENTIAL GUIDE to

PRICING & MODEL NUMBER SELECTION

DATE: NOVEMBER 17, 2007

REVISION: 00

CUSTOMER:		**QUOTE NUMBER:**	**3DQ-**
LOCATION:		**QUOTE DUE DATE:**	
CONTACT:		**PHONE #:**	

	1		2		3		4		5		6		7		8		9	
Model Number:	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-

	10		10		10		10		10		10		10		10		10	
#10 Options:	0	,	0	,	0	,	0	,	0	,	0	,	0	,	0	,	0	,

1 — Selection: **Must Select One** — Size of Vehicle: **E500** | **E3500**

2 — Selection: **Must Select One** — Vehicle Type

	E500	E3500
TUG	$ 11,170	$ 13,845
TNL	$ 12,272	$ 15,677
TNL_LIFT	N/A	N/A

TUG Includes: Drive & Steering Controls, Camera Guidance, External Circuit Breakers, Ethernet Port, Pendant Recovery Port, E-Stop PB, Master Power ON/OFF, Push Handle; Set-up for: (2) Ultrasonic sensors, (1) Photo-eye Bumper control (NOT Safety Rated) and (1) Proximity Sensor

TNL Incl: Drive & Steering Controls, Electric Lift Pin, CAM Guidance, External Circuit Breakers, Ethernet & Pendant Recovery Port, E-Stop PB, Master Power ON/OFF; **BASIC Control Operations** incl set-up for: (1) Laser "bumper" control (NOT Safety Rated) w/Expanded Memory and (1) Proximity Sensor ***must ADD (1) Prox. to actuate Electric Lift Pin***. If **STEP Control Operation** is used, DO NOT include 2nd Prox.

+

3 — Selection: **Must Select One** — Guidance

CAM	Color Camera with Tape Guidance
MAG	Magnetic Sensor with Magnetic Tape

+

4 — $ $ - — Selection: **Must Select ONE!!** — Control Operations

B	Incl in Base	NO STEP Control or HMI
S	$ 415	STEP Control w/GT01 HMI Display
SR	$ 1,530	STEP Control w/GT11 HMI Display & Cart-To-Cart Radio
SRM	$ 3,682	STEP Control w/GT01 HMI Display & Radio to MCCP

+

5 — $ — Selection: **Must Select One** — Battery Selection

Must Select ONE!!	**E500**	**E3500**	
GEL	$ 390	$ 780	
AGM	$ 760	$ 1,520	
MDC (Marine Deep Cycle)	$ -	$ -	Consult Factory
CSB (Customer Supplied)	$ -	$ -	
Batts/AGC	2 in 1 Tray	4 in 2 Trays	
Batt Chgr Input Volts	120 vac	120 vac	
Batt Chgr Output Amp.	25A	40A	

+

6 — $ — Selection: **Must Select One** — Charging Method

	25Amp	**40Amp**	
BC	$ 460	$ 685	Built in charger w/male extension cord plug for 120 Vac
BS	$ -	$ -	Batt Tray exchng (See Syst. Options for additional reqmts)
OC	$ -	$ -	Consult Factory
AC	$ -	$ -	Consult Factory
Charger Loose	$ -	$ -	

+

7 — $ $ - — Selection: **Must Select One** — Bumper(s)

NB	$0	NO Bumper
FB	$140	Flexible Bumper (NOT Safety Rated)
SRFB	Consult Factory	Safety Rated Flexible Bumper

+

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		Selection				
8	$		Must Select One Collision Avoidance Sensors	US	$505	2 Ultrasonic Sensors & Brkts/Cart. Use w/FB (I tem 7 above).
				LS	$2,146	1 Laser per Cart (NOT Safety Rated)
				SLS	Consult Factory	1 Laser per Cart (Safety Rated)

+

		Selection					
9	$		Must Select One Sound Modules	M	$ 180	Melody Module: 2 Melodies + 2 Chimes	Mounted in Cart
				H	$ 59	Single soundé obnoxious beeper.	Control Panel

+

	Options List $		Select ALL That Apply		
10	$ -	Misc. Options & Configs	A1	Battery Fuel Gauge (Std w/ HMI Display)	$ 142
			A2	Hand-Held Drive Recovery Pendant (Remote)	$ 177
			A3	Additional Floor Proximity Sensor w/Mtg Brkt	$ 192
			A4	Additional Ultrasonic Sensor w/Mtg Brkt	$ 239
			A5	Remote Cycle Start/Stop PB (needs A6)	$ 192
			A6	Warning Light w/Adjustable Mast (Madonna)	$ 253
			A7	Additional E-Stop PB (Needs A6)	$ 192
			A8	Add. E-Stop, Start/Stop PB J-Box (Needs A6)	$ 369
			A9	3-Light Stack (RYG) w/Mtg Box, Brkt and Stub.	$ 330
			B1	Wide Load Protection	$ -
			B2	Additional Adjustable Mast (No J-Box)	$ 105
			B3		$ -
			B4		$ -
			B5		$ -
			CEC	Cable: Ethernet Crossover Cable (7 ft)	$ 60 Web Page
			CSC	Cable: Serial Cable	$ 30 Laser Scanner
			CRM	Cable: Rabbit Microprocessor Cable	$ 60 Download Rabbit
			HMI	Cable: HMI Programming Cable	$ 90 Touchscreen
			SP()	STOP Plate QTY ( )	$ 25 Each
			CWT()	Cart Counterweight 50 lbs each	$ -
			PIP()	Part-In-Place Sensor. Put Qty of Sensors in ().	$ 192
			MPS1	1 Day Mech Support w/Expenses (On-Site)	$ -
			MPS2	2 Days Mech Support w/Expenses (On-Site)	$ -
			MPS3	3 Days Mech Support w/Expenses (On-Site)	$ -
			MPS4	4 Days Mech Support w/Expenses (On-Site)	$ -
			CPS1	1 Day Controls Support w/Expenses (On-Site)	$ 1,412
			CPS2	2 Days Controls Support w/Expenses (On-Site)	$ 2,824
			CPS3	3 Days Controls Support w/Expenses (On-Site)	$ 4,236
			CPS4	4 Days Controls Support w/Expenses (On-Site)	$ 5,648

Option Selection	List Price (Each)
	$ -
	$ -
	$ -
	$ -
	$ -
	$ -
	$ -
	$ -
	$ -

=

11	$ -	LIST PRICE / CART
		QTY OF CARTS
12	$ -	TOTAL LIST PRICE OF CARTS

Shop Buy-Off					
	Y	Marine City, MI	OR	Dimondale, MI	
	N	One (1) Cart		All Carts	
	Mech $650/Day	# of Days	Controls $900/Day	# of Days	
	Freight Origin	FOB Marine City, MI			

NOTES AND CLARIFICATIONS:

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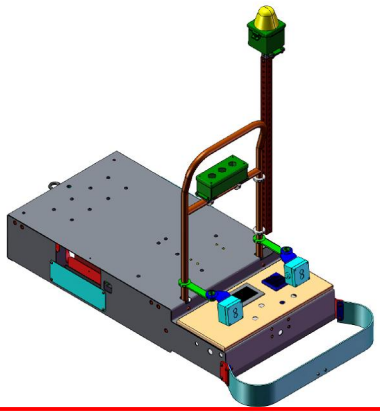
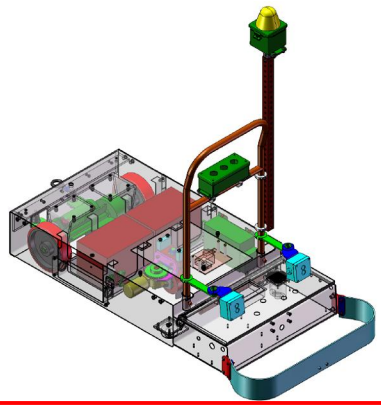
AUTOCRAFT TOOL & DIE

AUTO-CART - AUTOMATIC GUIDED CART

MODEL: E500 UNIT LOAD TUGGER AGC SPECIFICATIONS





AUTO-CART STANDARD FEATURES:

- **Drive and Steering:**
  - 24 VDC differential transaxle w/ motor and an electrically released, spring set, fail-safe brake;
  - 8ð208.4mm diameter Urethane drive wheels;
  - Linear position feed-back sensor;
  - High torque steering actuator;
  - 4ò dia. spur gear driven Urethane steering wheel;
  - Steering position feed-back module;
- **Guidance:**
  - Digital video camera with custom algorithms;
  - Modulated, uniform, self-contained light source;
  - Guidepath tape re-teach or program new color;
  - Dead reckoning capable;
  - Loss of guidance sensing;
- **Cart Controls:**
  - A dedicated micro-processor core module controls: speed, steering, guidepath imaging and the linear STEP program;
  - Operator controls;
  - Obstacle detection and bumper control;
  - Diagnostics
  - Battery and charger management;
  - Web page control and interface;
  - Communication interfaces, when necessary;
  - Part present and Stop floor marker detection;
- **Visible Diagnostics:**
  - Battery condition, low;
  - Loss of guidepath;
  - Obstacle detected;

AUTO-CART STANDARD FEATURES (Con't):

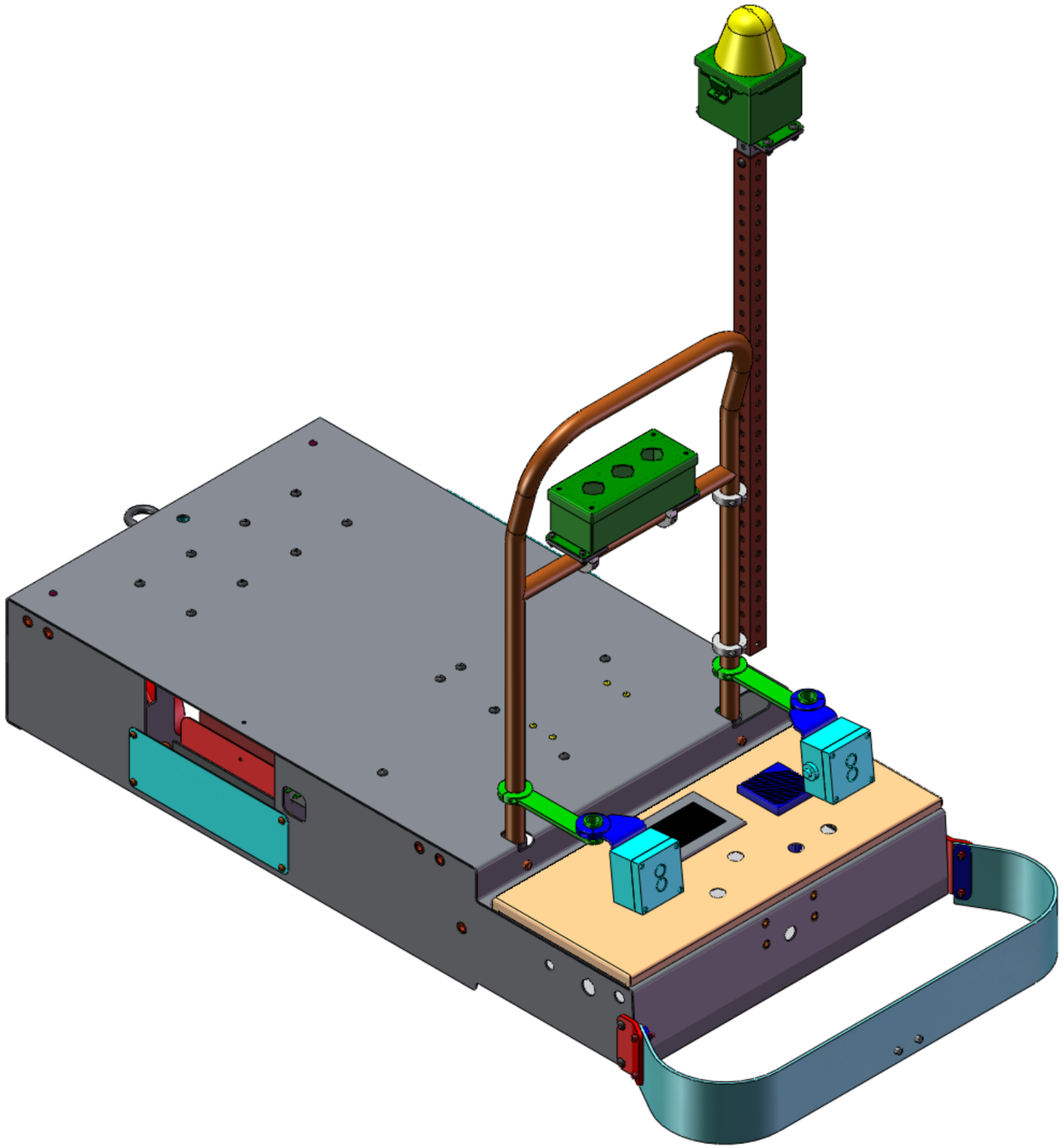
- **Speed Control:**
  - Pulse Width Modulated (PWM)
  - High bred ñClosedòloop
  - Automatic deceleration in curves and selected straight sections without programming;
  - Programmable speeds
  - Automatic speed selection with the STEP programming module;
- **Battery and Charger:**
  - (2) 12 VDC GEL @ 71 Amp Hour;
  - 24 VDC, motor operating voltage;
  - 25 amp ñsmartòcharger, (3) auto charge levels;
  - Removable battery tray for easy recharging;
  - Quick connectors for faster battery exchange;

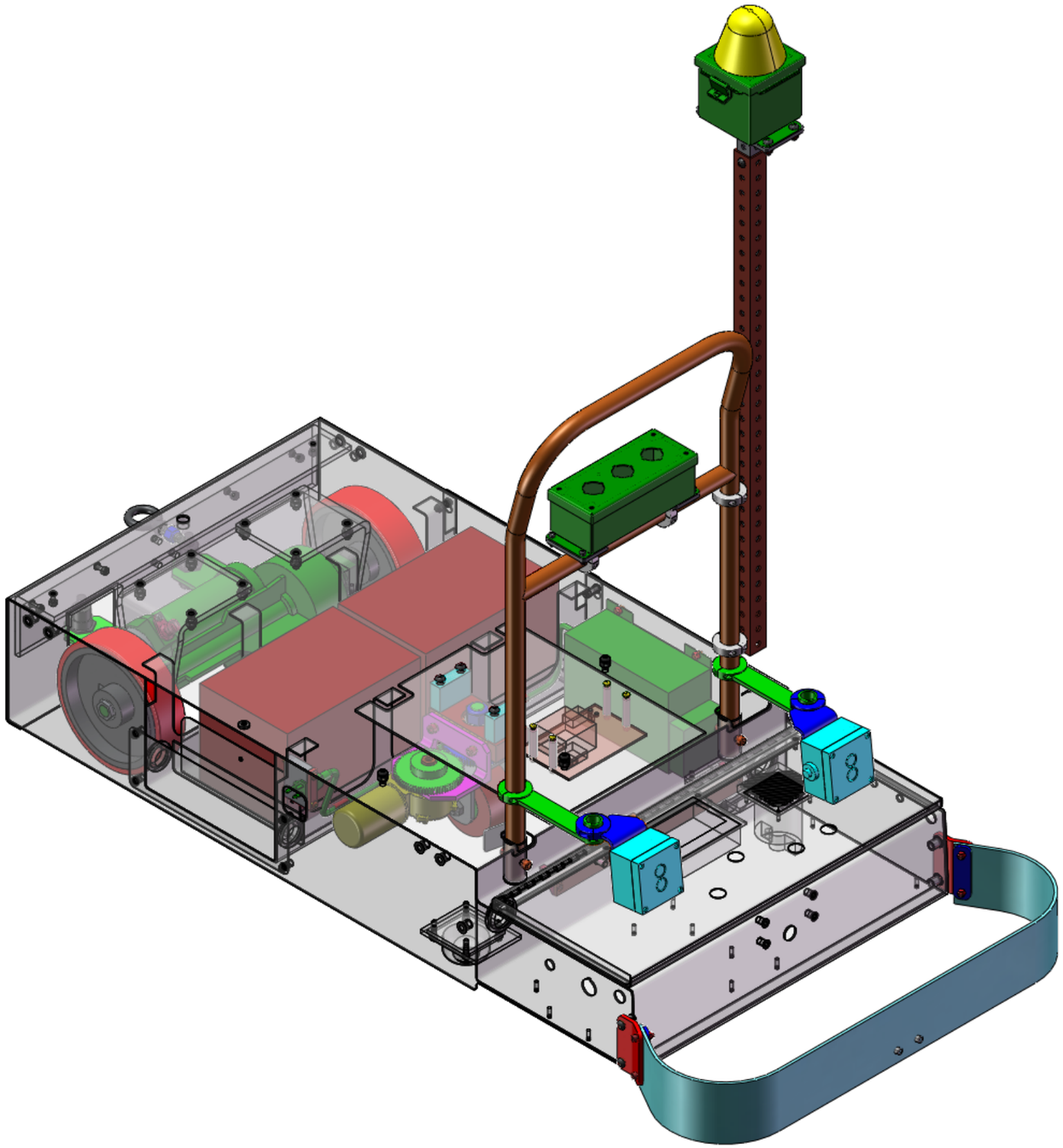
SPECIFICATIONS:

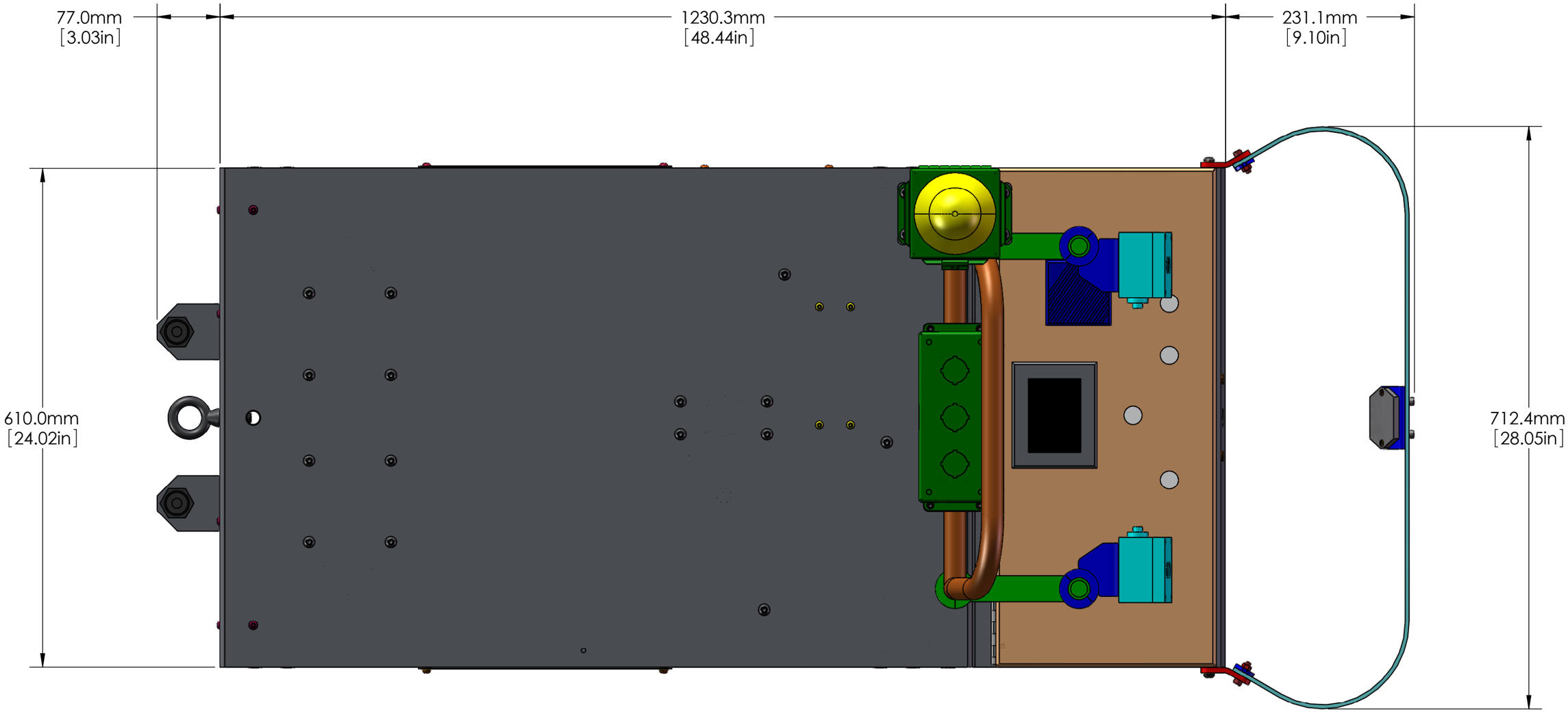
- Live load capacity (on deck)é é é ..é é .é é é ...500 lbs
- Tugger Capacityé é ..é é é é é é é é ..Up To 1000 lbs
- Mule wt w/batteries and chargeré é é é é .....250 lbs
- Max. Speed .é é é é é é é é é é é é é .é 225 FPM
- Drive Voltage....é é é é é é é é é é é é é ..24 VDC
- Stopping Accuracy .é é é é é é é é ..é é ..±.25 Inch
- Ground Clearance.é é ..é é é é é é é é é é ..1 inch
- Min. Turn Radius (90°)..é é é é é .25 inches @ 90 FPM
- Deck Dimensions.....é é é é ...36òL x 24òW x 9òH
- Deck Materialé Pre-Punched, Formed and Welded Steel

NOTES:

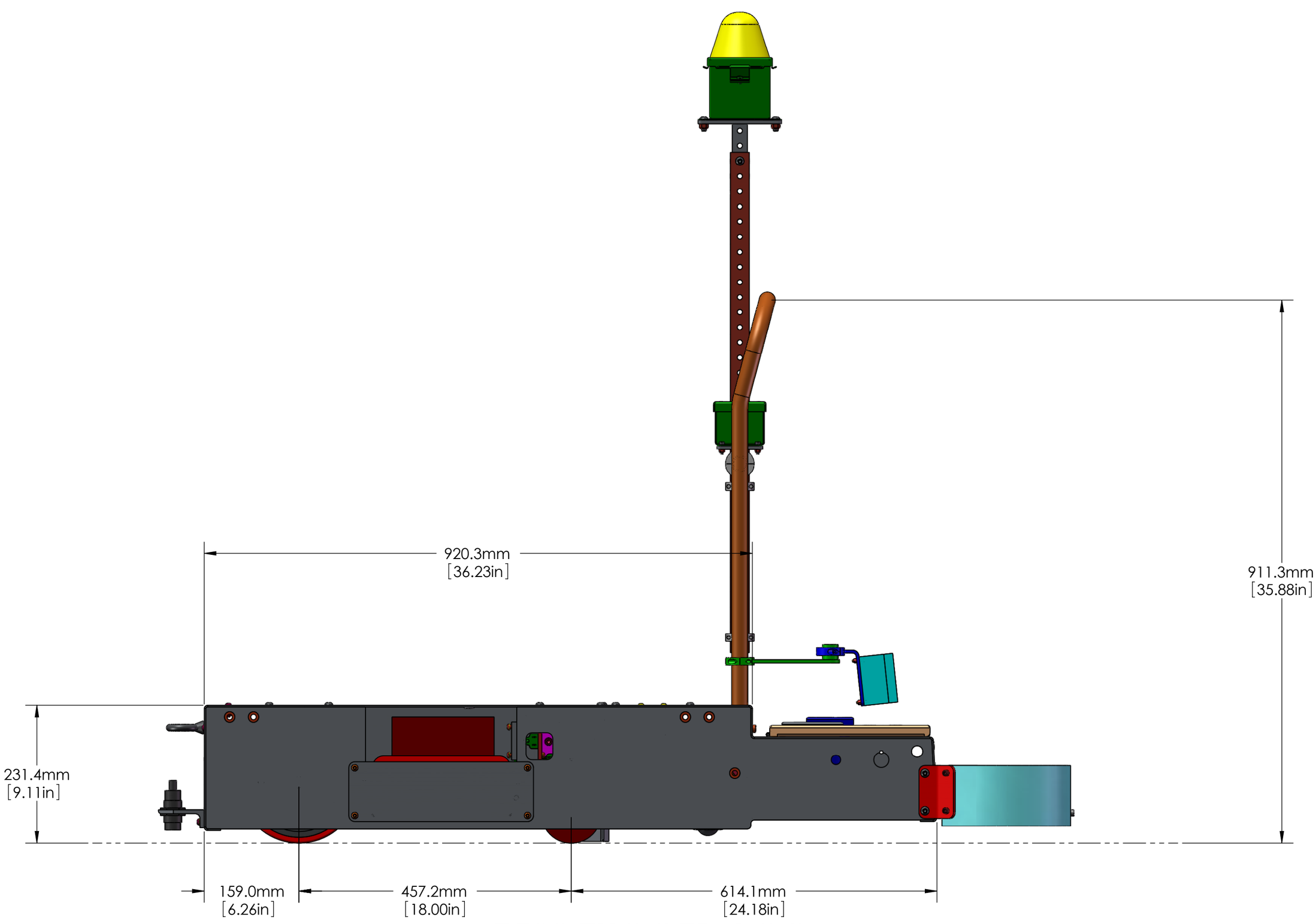
Please consult the factory for a list of options, price, delivery and AGC application assistance. Demo and proto-type vehicles may be available, contact you sales representative for details. Specifications may change without notice. Contact the factory if there are questions.







E500 TUGGER AGC
PLAN VIEW



E500 TUGGER AGC
SIDE VIEW

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MODEL: E-500 TUNNEL AGC SPECIFICATIONS

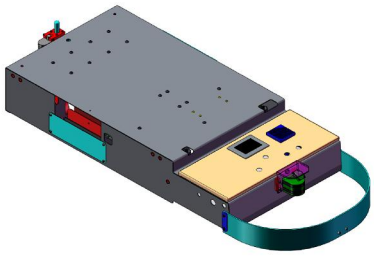
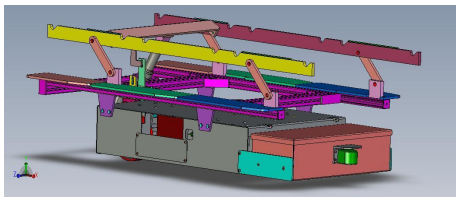


FIGURE ABOVE
Solid View of TUNNEL AGC with Electrically Actuated Tow Pin and Proximity Switch in Rear of TUNNEL AGC

PICTURED BELOW
Tote Rack Delivery System – TUNNEL Application Automatically Raises Tote Rack and Delivers It to an Assembly Line and Picks It up When Empty



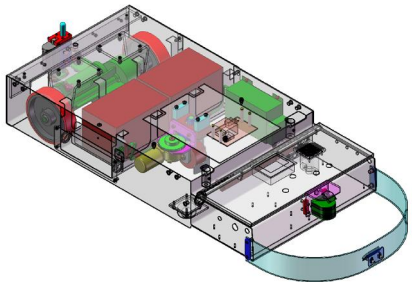


FIGURE ABOVE
Transparent View of TUNNEL AGC without Controls Details

AUTO-CART STANDARD FEATURES:

- **Drive and Steering:**
  - 24 VDC differential transaxle w/ motor and an electrically released, spring set, fail-safe brake;
  - 8ò208.4mm diameter Urethane drive wheels;
  - Linear position feed-back sensor;
  - High torque steering actuator;
  - 4òdia. spur gear driven Urethane steering wheel;
  - Steering position feed-back module;
- **Guidance:**
  - Digital video camera with custom algorithms;
  - Modulated, uniform, self-contained light source;
  - Guidepath tape re-teach or program new color;
  - Dead reckoning capable;
  - Loss of guidance sensing;
- **Cart Controls:**
  - A dedicated micro-processor core module controls: speed, steering, guidepath imaging and the linear STEP program;
  - Operator controls;
  - Obstacle detection;
  - Diagnostics
  - Low Battery Chime
  - Battery and charger management;
  - Web page control and interface;
  - Communication interfaces, when necessary;
  - Part present and Stop floor marker detection;
  - Automatic tow pin engage and disengage;
- **Visible Diagnostics:**
  - Battery condition, low;
  - Loss of guidepath;
  - Obstacle detected;

AUTO-CART STANDARD FEATURES (Con't):

- **Speed Control:**
  - Pulse Width Modulated (PWM)
  - High bred ñClosedòloop
  - Automatic deceleration in curves and selected straight sections without programming;
  - Programmable speeds
  - Automatic speed selection with the STEP programming module;
- **Battery and Charger:**
  - (2) 12 VDC GEL @ 71 Amp Hour;
  - 24 VDC, motor operating voltage;
  - 25 amp ñsmartòcharger, (3) auto charge levels;
  - Removable battery tray for easy recharging;
  - Quick connectors for faster battery exchange;

SPECIFICATIONS:

- Live Load Towing Capacity.é é é é é é .Up to 1000 lbs
- Deck Capacityé é é é é é é é é é é é é é ..500 lbs
- AGC weight w/batteries and chargeré .....325 lbs
- Max. Speed..é é é é é é é é é é é é é é 225 FPM
- Drive Voltage....é é é é é é é é é é é é é ..24 VDC
- Stopping Accuracy..é é é é é é é é é é ..~±.25 Inch
- Ground Clearance.é é ..é é é é é é é .....1 inch
- Min. Turn Radius (90°)...é é é é é 25 inches @ 90 FPM
- Deck Dimensions.....é é é é ...36òL x 24òW x 9òH
- OA Vehicle Sizeé é é é é é é é 55òL x 24òW x 9òH
- Deck Materialé ..Steel: Pre-Punched, Formed & Welded

NOTES:

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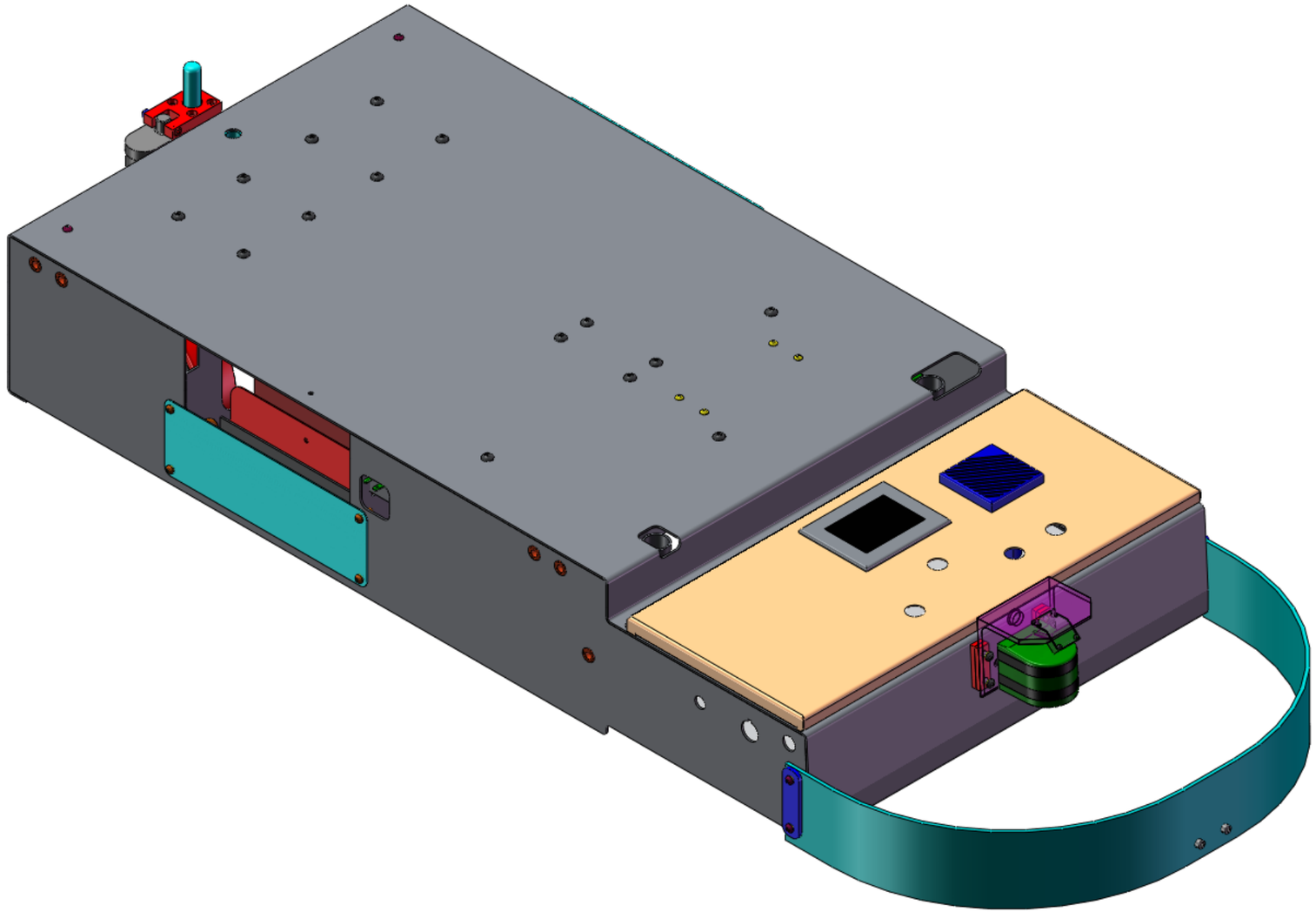
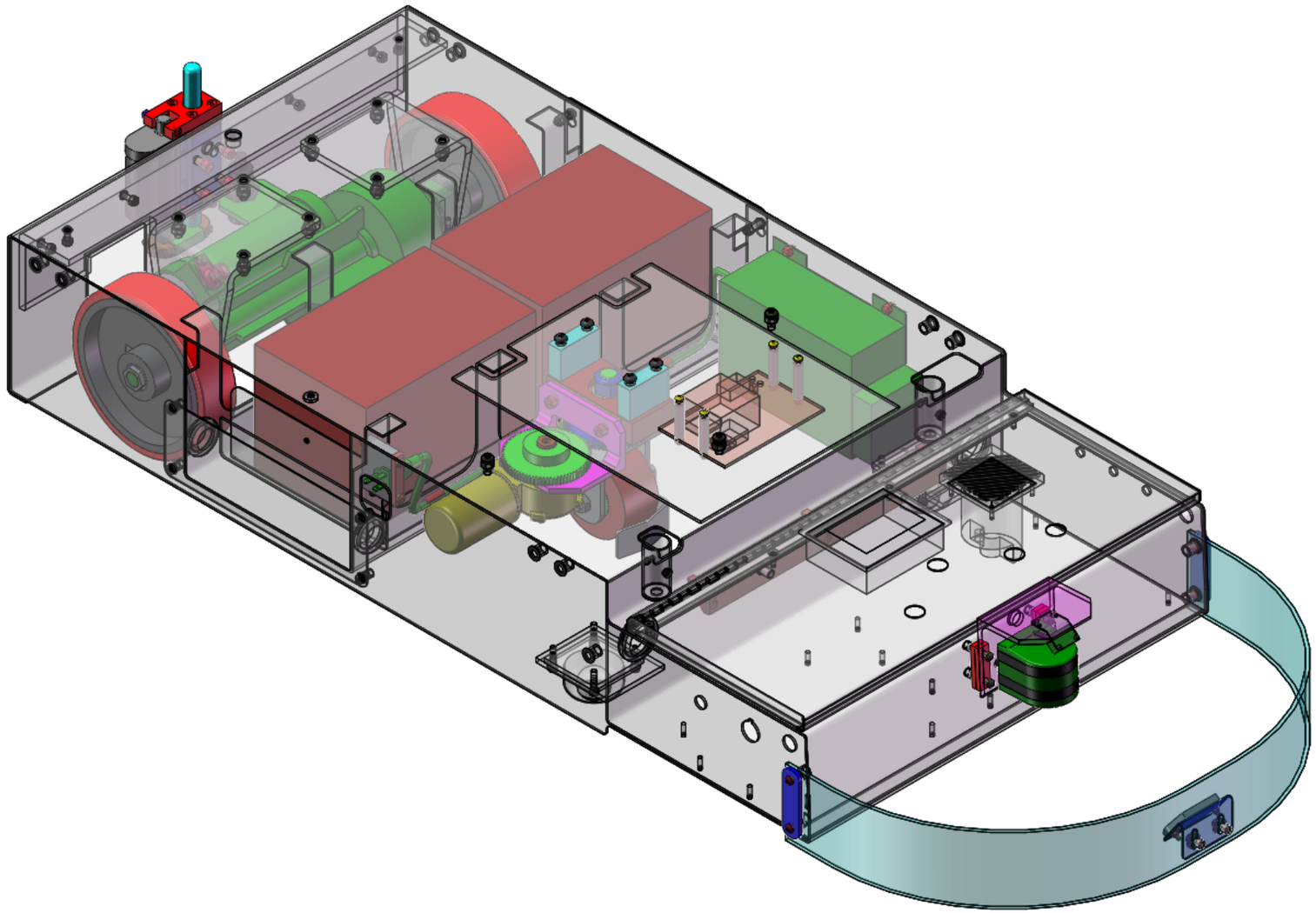
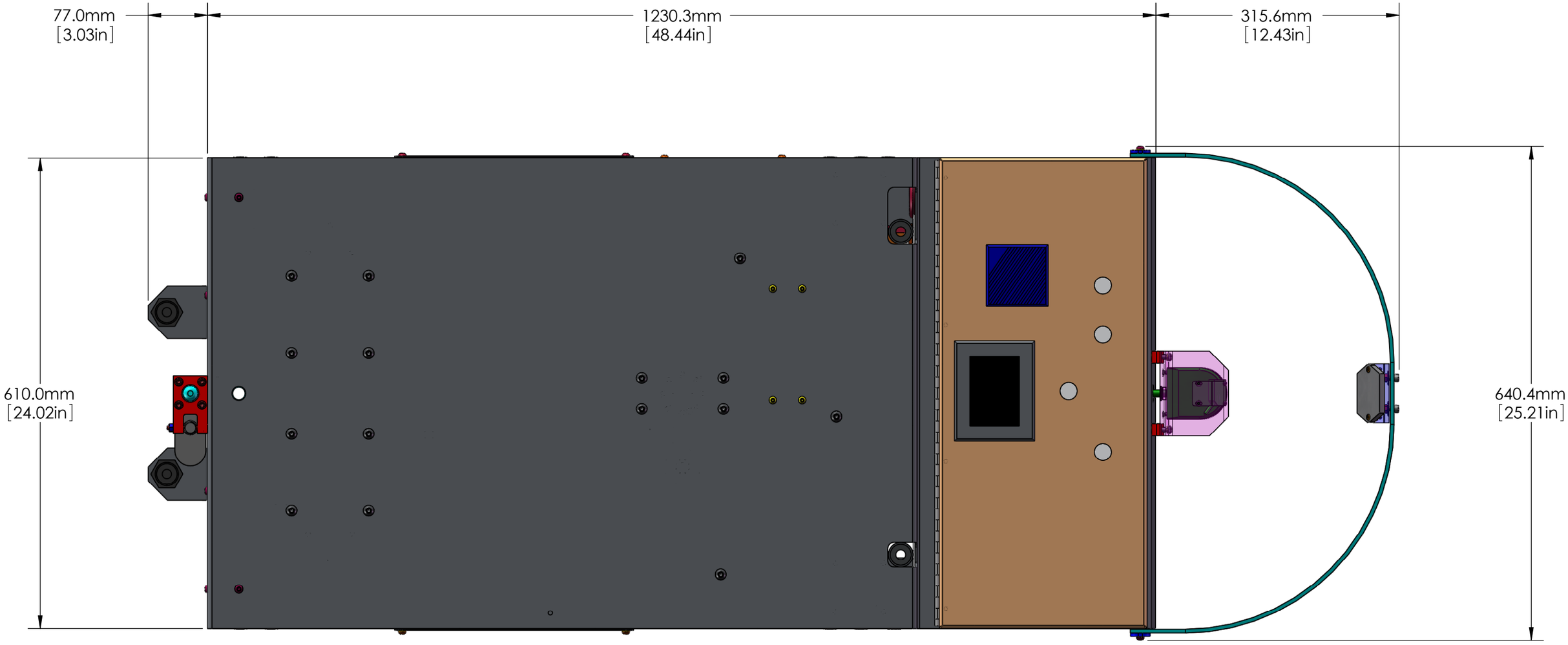
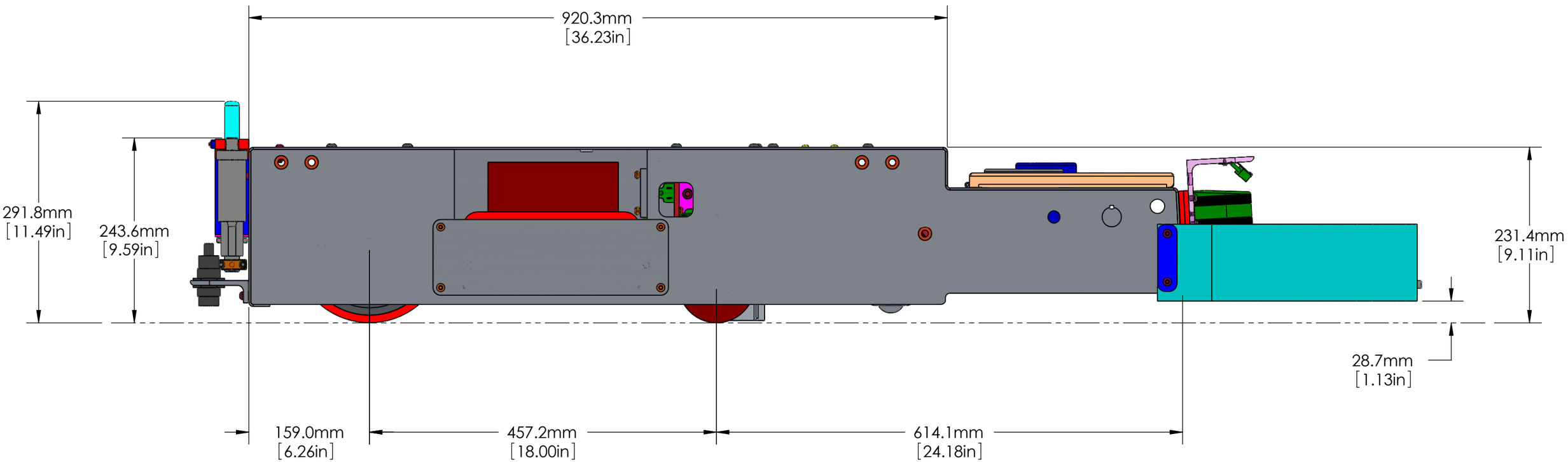






E500 TUNNEL AGC
PLAN VIEW



E500 TUNNEL AGC
SIDE VIEW

THREE-D SALES, INC.
604 Smith Street, Algonac, MI 48001
www.threedsales.com
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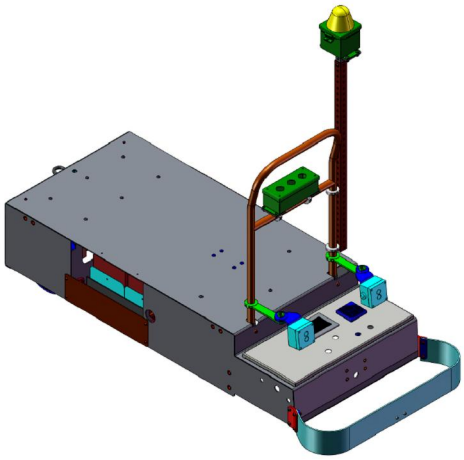
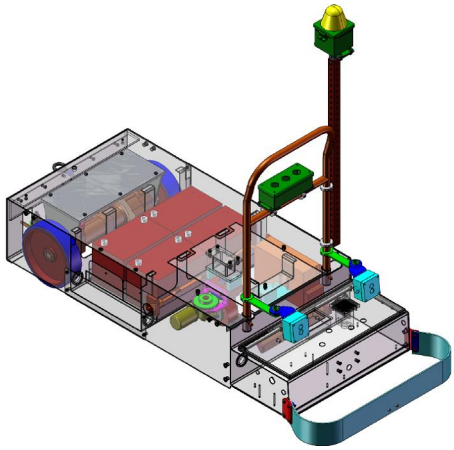
AUTOCRAFT
TOOL & DIE

AUTO-CART - AUTOMATIC GUIDED CART

MODEL: E-3500 UNIT LOAD/TUGGER AGC





AUTO-CART STANDARD FEATURES:

- **Drive and Steering:**
  - 24VDC Medium Duty differential transaxle w/motor & electric released, spring set, fail-safe brake;
  - 10ò diameter Urethane drive wheels;
  - Linear position feed-back sensor;
  - High torque steering actuator;
  - 4ò dia. spur gear driven Urethane steering wheel;
  - Steering position feed-back module;
  - Heavy Duty Drive with cooling module
  - Voltage multiplier brake module
- **Guidance:**
  - Digital video camera with customized algorithms;
  - Modulated, uniform, self-contained light source;
  - Guidepath tape re-teach to program new color;
  - Dead reckoning capability;
  - Loss of guidance sensing;
  - Ultra-sonic setup chime;
- **Cart Controls:**
  - Dedicated micro-processor core module controls: speed, steering, guidepath imaging & linear STEP program;
  - Operator controls;
  - Obstacle detection and bumper control;
  - Diagnostics;
  - Low Battery Chime;
  - Battery and charger management;
  - Web page control and interface;
  - Communication interfaces, when necessary;
  - Part present and Stop floor marker detection;
- **Visual Diagnostics:**
  - Battery condition, low;
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AUTO-CART STANDARD FEATURES (Con't):

- **Speed Control:**
  - Pulse Width Modulated (PWM);
  - High bred ñClosedòloop;
  - Automatic deceleration in curves and selected straight sections without programming;
  - Programmable speeds;
  - Automatic speed selection with the STEP programming module;
- **Battery and Charger:**
  - (4) 12 VDC GEL @ 71 AH each; ~140 total AH
  - 24 VDC, motor operating voltage;
  - 40 amp ñSmartòcharger, (3) auto charge levels;
  - Removable battery tray for easy recharging;
  - Quick connectors for faster battery exchange;

SPECIFICATIONS:

- Live load capacity (on deck)é é é é é é .é é ..1000 lbs
- Drive Train Pullé é é é é é é é .é é ....Up To 3500 lbs
- Mule weight w/batteries and chargeré .....~450 lbs
- Max. Speed..é é é é é é é é é é é é é é é 150 FPM
- Drive Voltage....é é é é é é é é é é é é é é ..24 VDC
- Stopping Accuracy..é é é é é é é é é é é é ~±.5 Inch
- Ground Clearance.é é ..é é é é é é é é .....1 inch
- Min. Turn Radius (90°)...é é é é 39 inches @ 90 FPM
- Deck Dimensions.....é é é ....46òL x 25òW x 12òH
- Deck Materialé ..Steel: Pre-Punched, Formed & Welded

NOTES:

Please consult the factory for a list of options, price, delivery and AGC application assistance. Demo and proto-type vehicles may be available, contact you sales representative for details. Specifications may change without noticeé check with the factory before ordering.

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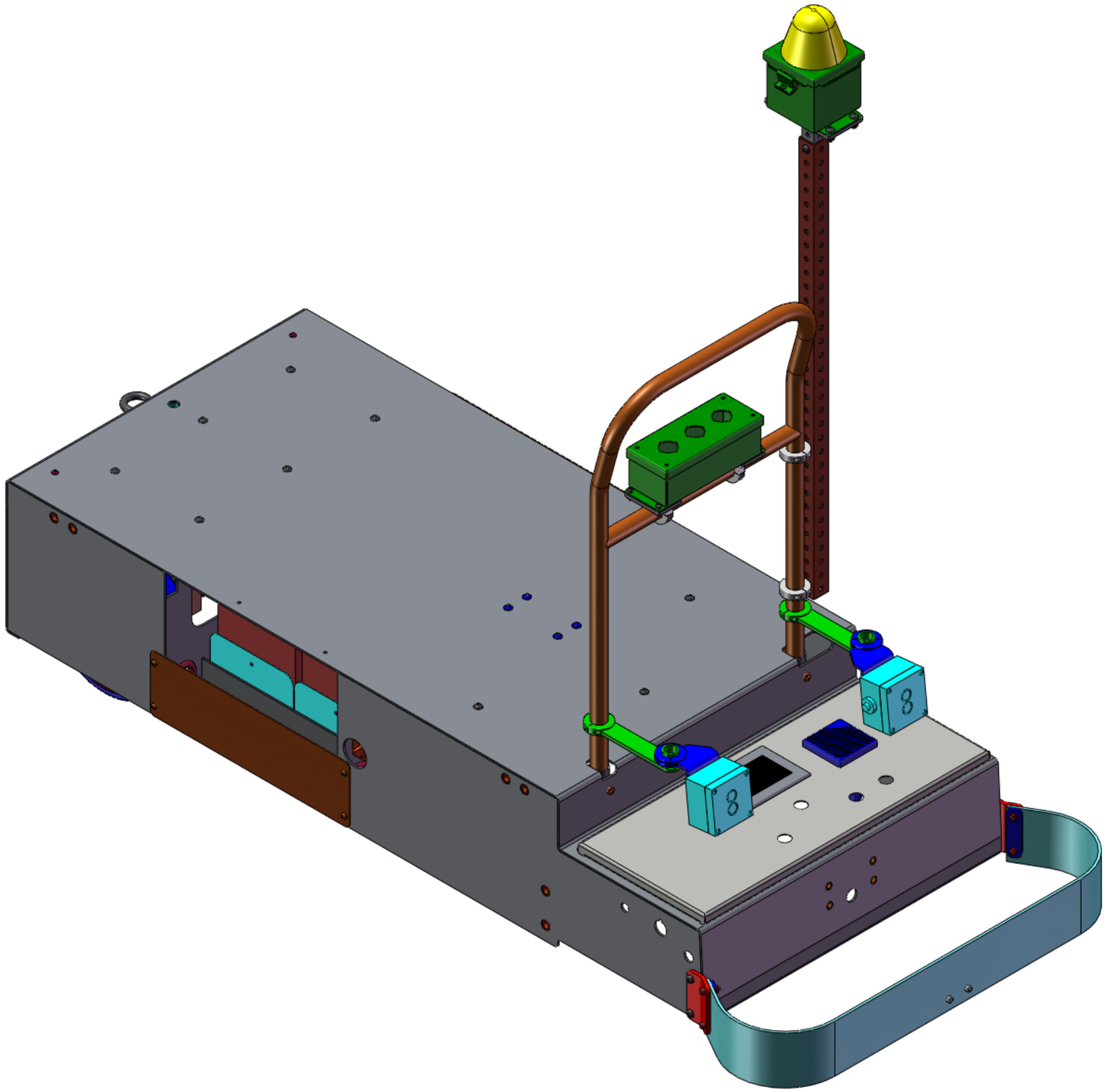
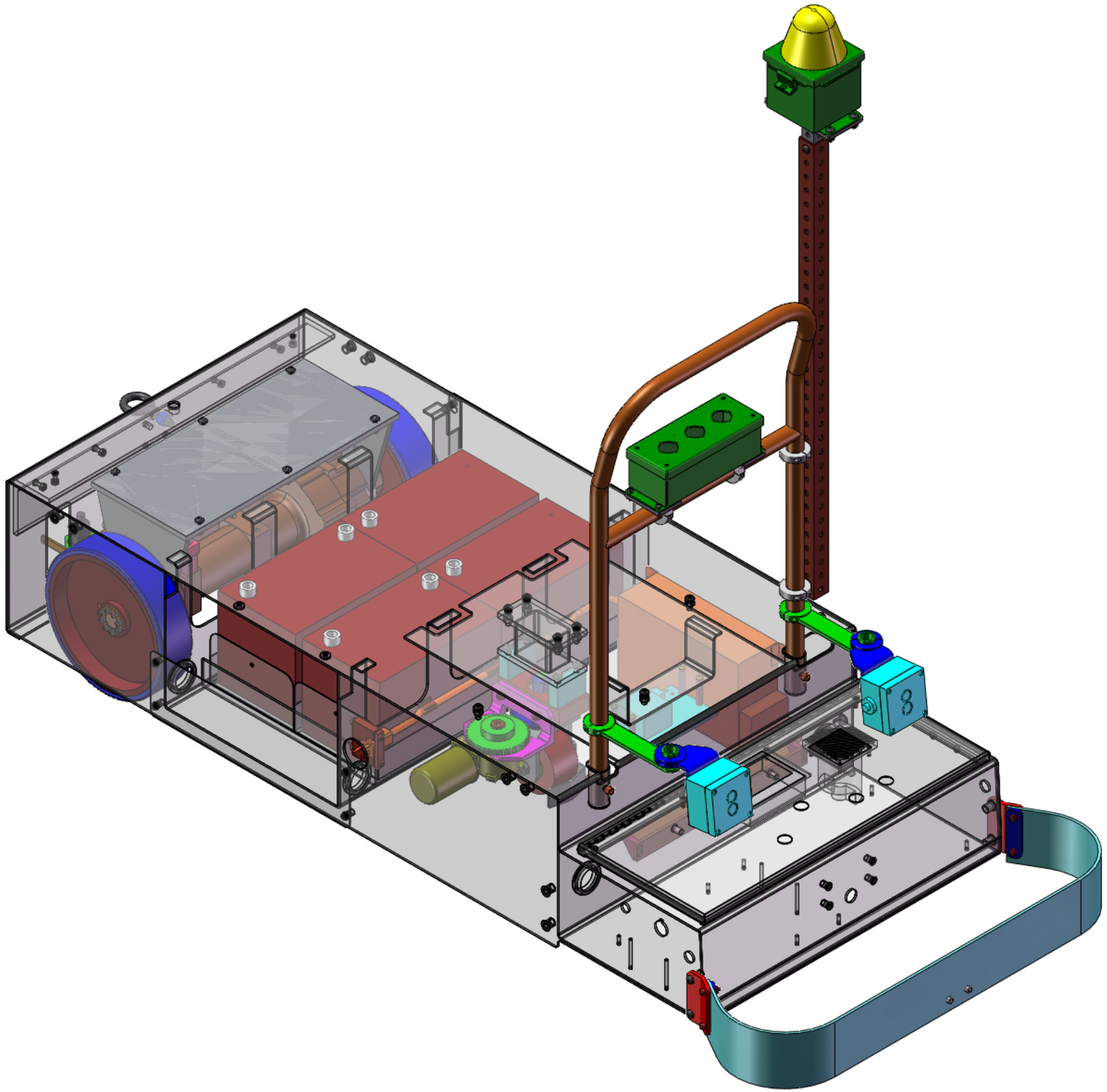
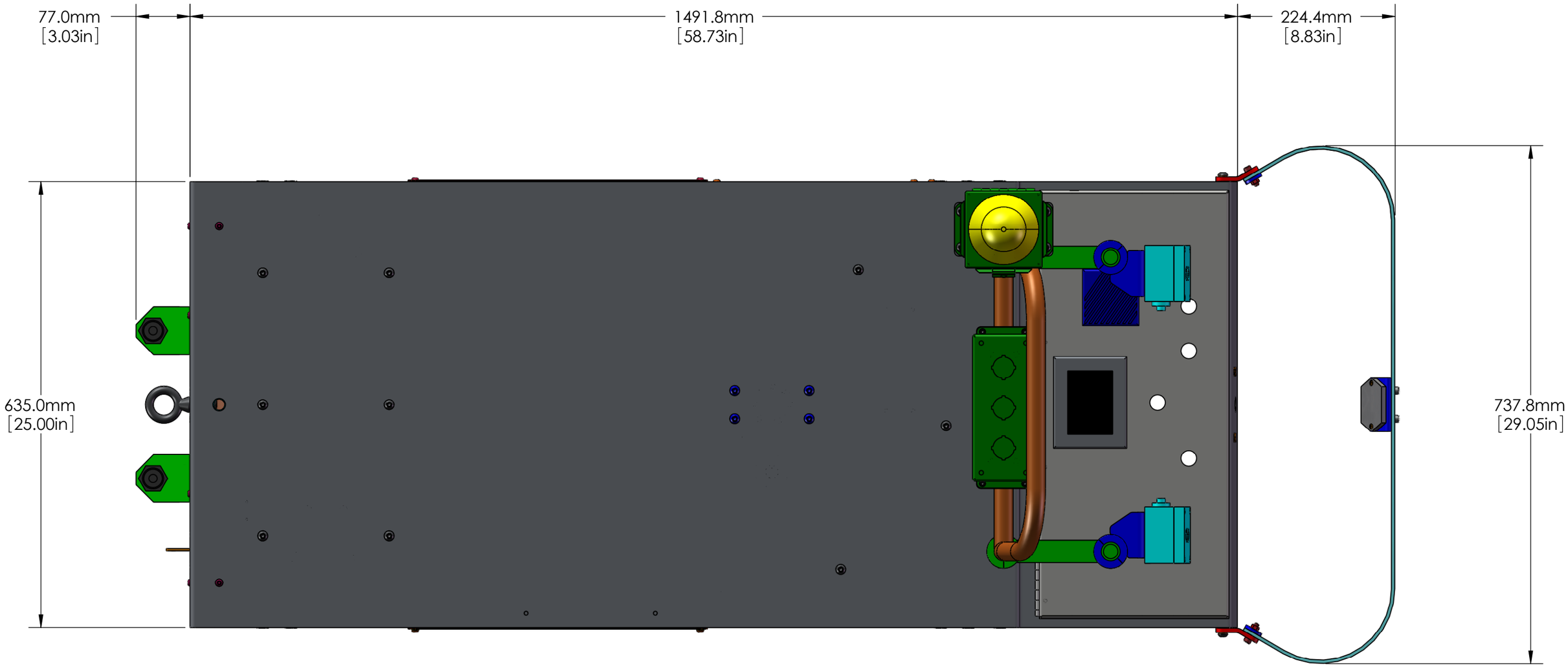
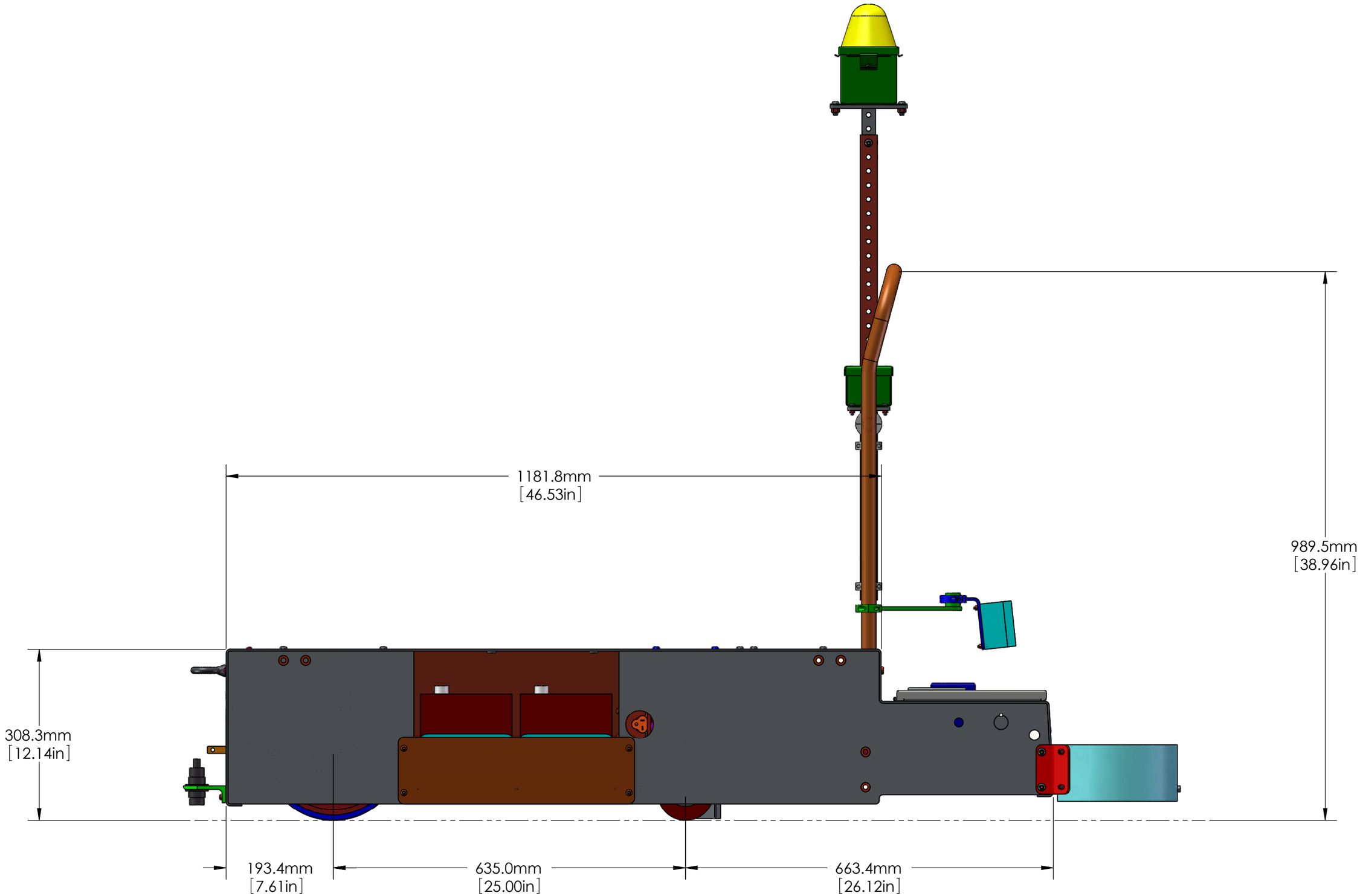






E3500 TUGGER AGC
PLAN VIEW



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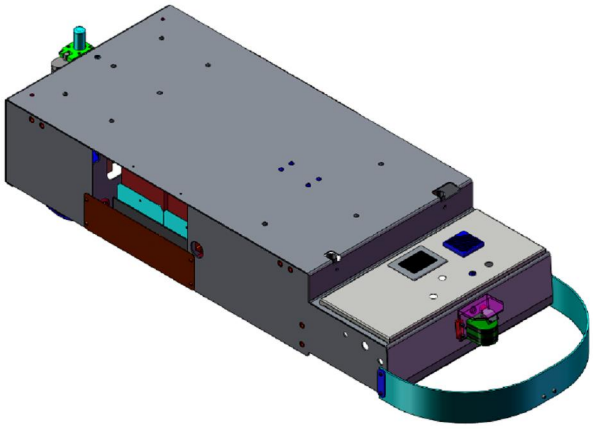
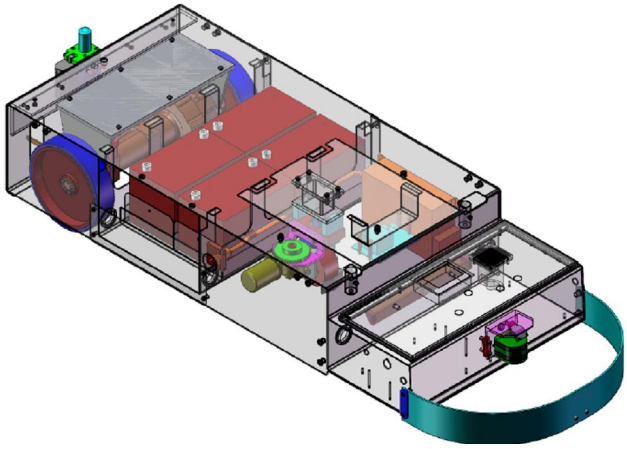
AUTOCRAFT TOOL & DIE

AUTO-CART - AUTOMATIC GUIDED CART

MODEL: E3500 TUNNEL STYLE AGC SPECIFICATIONS





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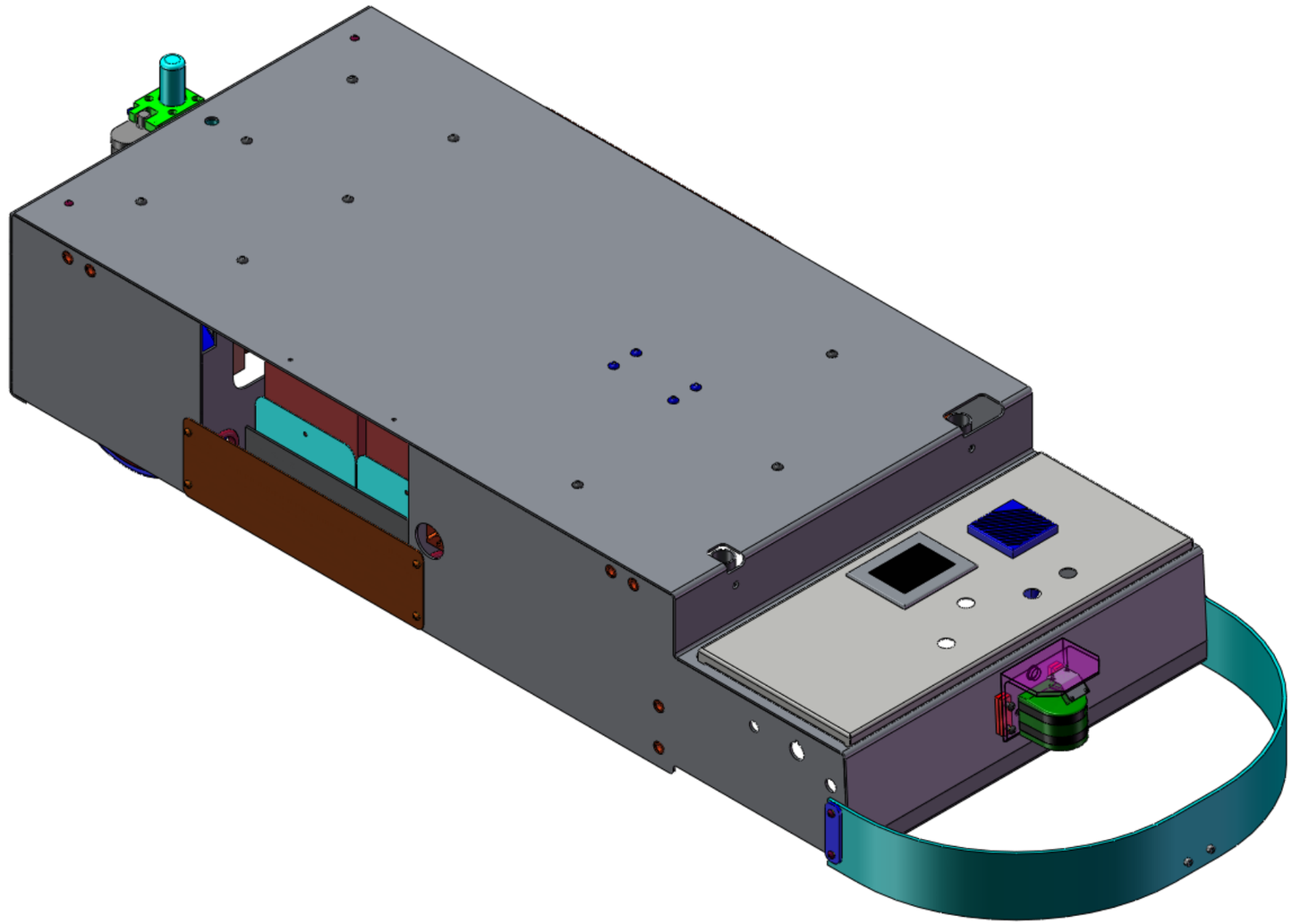
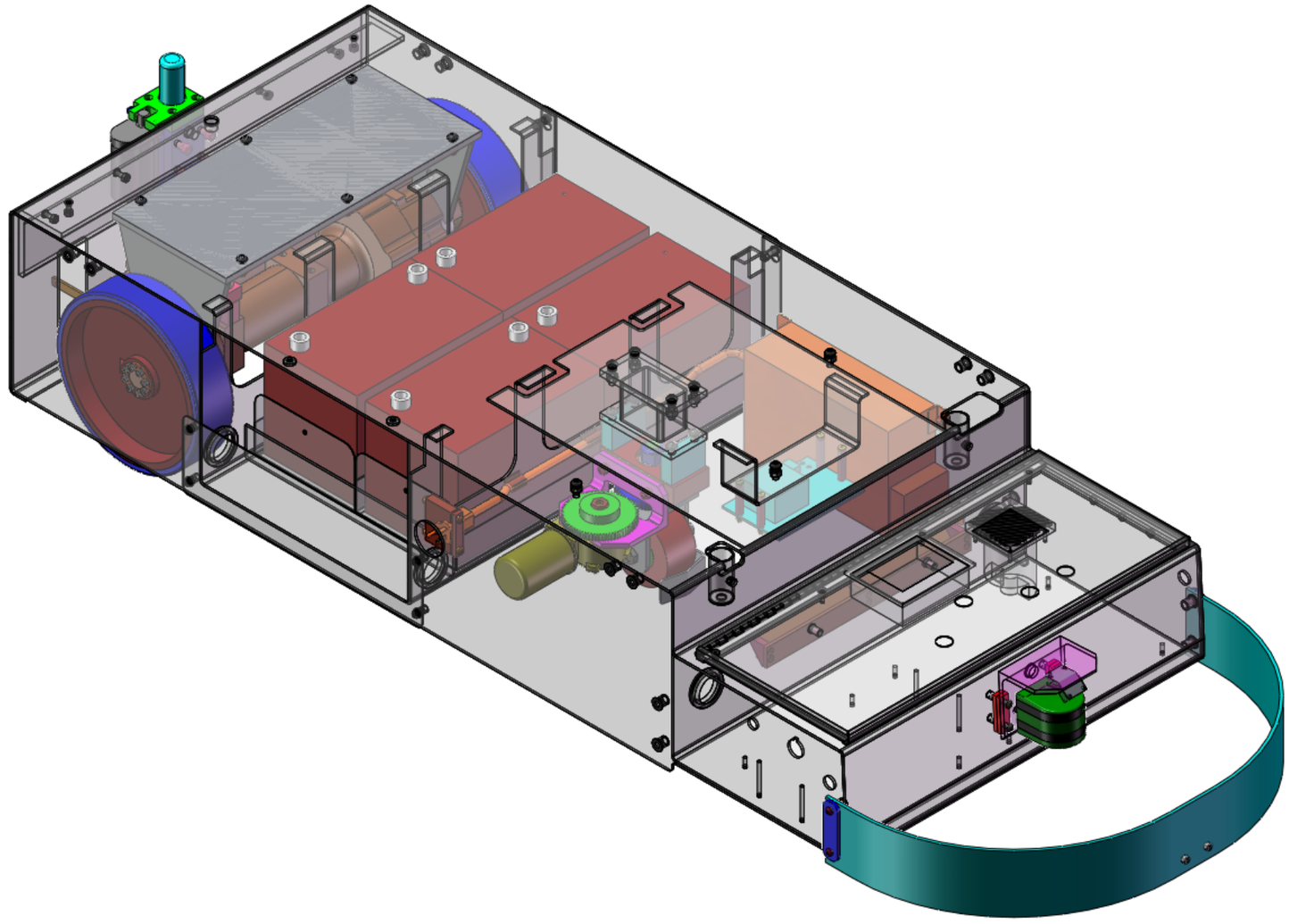
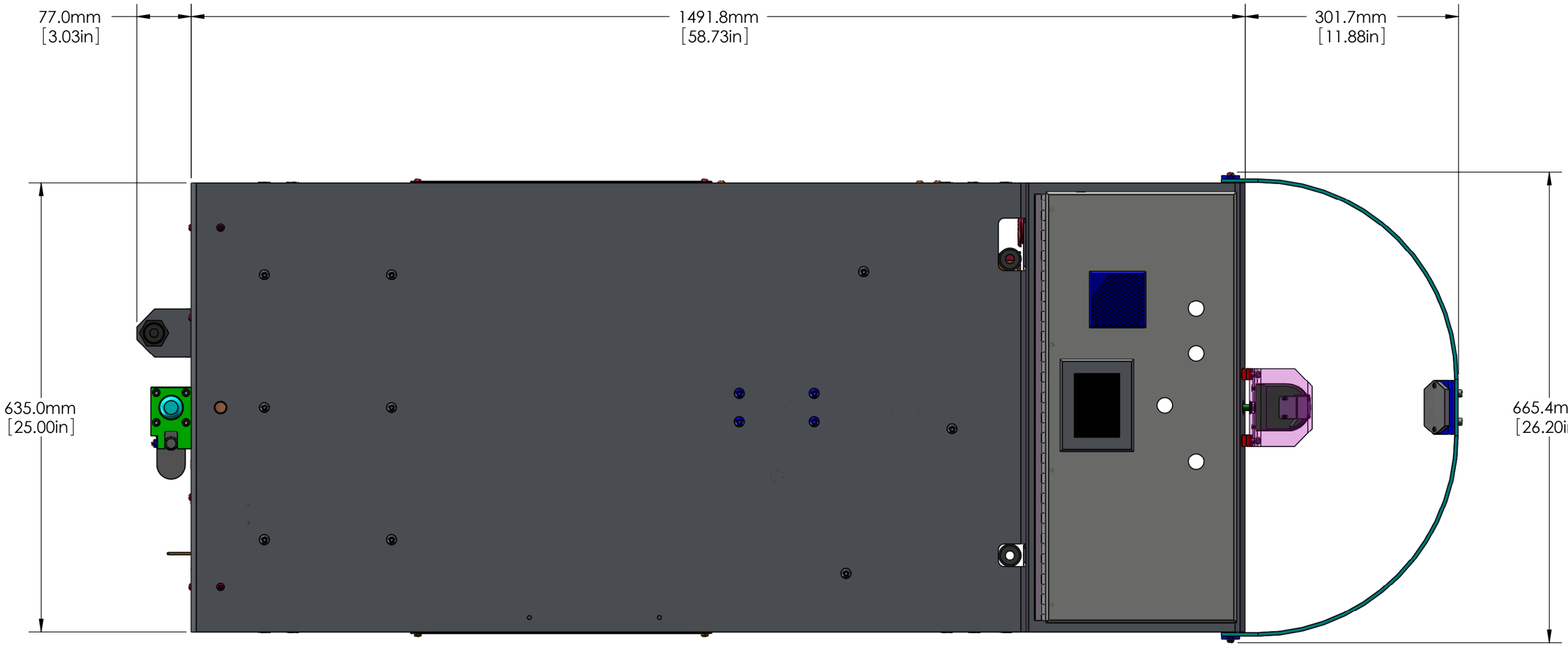
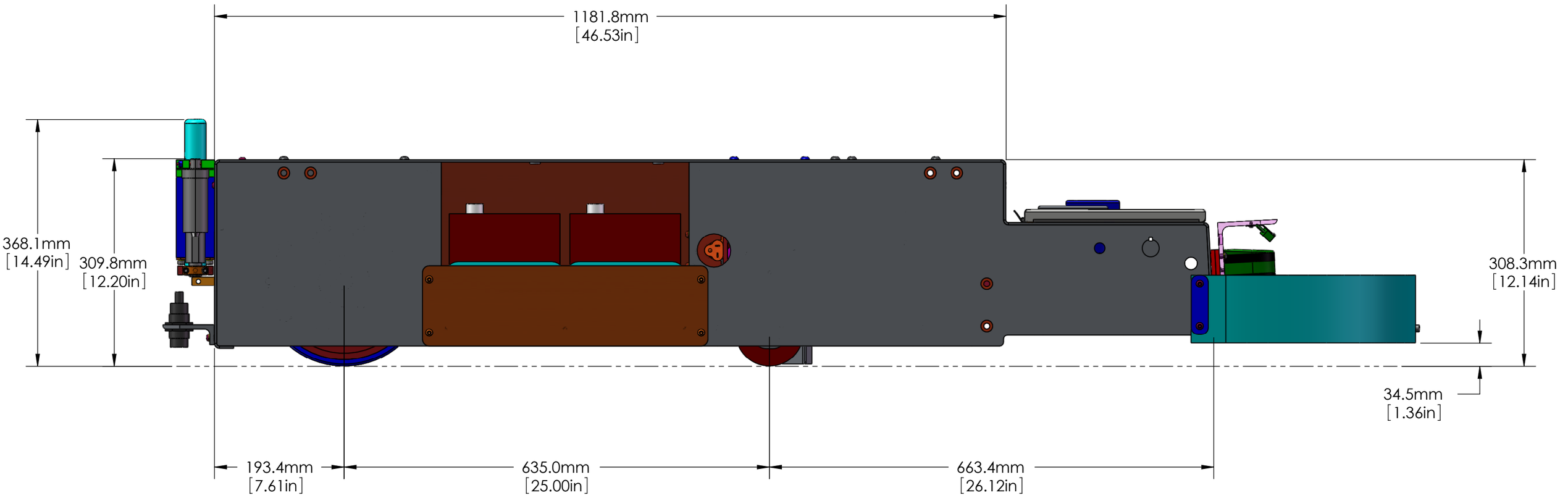






E3500 TUNNEL AGC
PLAN VIEW



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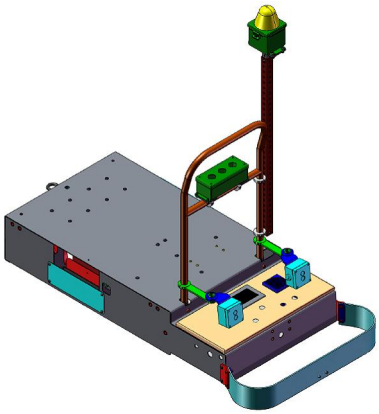
FREQUENTLY ASK ED QUESTIONS



FAQ
TABLE of CONTENTS

FREQUENTLY ASKED QUESTIONS (Continued)

FREQUENTLY ASKED QUESTIONS (Continued)

1. **How fast can an AGC travel?**
   ANS.: We experimented and helped train an athlete for a triathlon. This speed is not recommended. Our vehicles are comfortable at a "creep" speed to 165 fpm and up to 225 fpm.

2. **How does the AGC know where it is?**
   ANS.: Our vehicles have an automotive grade pulse counter built into the drive motor. It is mounted on the drive motor to provide a very high resolution.

3. **How is the AGC guided?**
   ANS.: We have developed an improved digital camera algorithm which allows the AGC to perform tasks which would normally require a computer interface. The algorithm is used for multiple purposes in the decision logic of the AGC.

4. **Does an AGC need be put on the path at only one specific location?**
   ANS.: Depending on the type of system you require, "from-to" or detailed routing selection, the AGC can be introduced anywhere on the guidepath. The AGC will determine where it is when it reaches the next "STOP" plate. All location information is contained on the AGC without need for an upper level control system. The cart will travel at a slow speed until it reaches the next passive floor marker plate.

5. **Is an upper level control system required in complex systems?**
   ANS.: An upper level control system, PLC in our case, is ONLY required if communications is required with a Factory Information System or there are interlocks required for robots, conveyor or tooling interfaces.

6. **Do we need to install a wireless system in our plant?**
   ANS.: No, there is no need to install a wireless system, if you do not have one. As a matter of fact, we would prefer to have our own independent wireless system so we can control the communication traffic. If we must be on your wireless system, we would request that we be assigned as a node on the network so we can control the communication traffic.

7. **Does your communication system "speak" only when spoken to?**
   ANS.: One of the reasons we prefer a stand-alone wireless system is that we can "continuously" communicate with each cart and know where it is at all times. This allows a real time map to be shown on an HMI as well as battery updates and other diagnostic and status bits. We do not have to wait for RF or magnetic inputs to determine our carts position.

8. **How does your cart know where to STOP?**
   ANS.: We use a STEP program, based on our incremental encoder, to provide cart function and location. Passive floor markers are used to provide a hard STOP for a workstation. A soft, programmed STOP is also used where positional accuracy is less important. The STEP program is resident on the cart and therefore does not need any off-board intelligence.

9. **How do you handle the positional error (count) created by drive wheel slippage or skidding to a stop?**
   ANS.: We have 2 ways to correct the count. We can do periodic soft resets with the STEP program or passive floor marker plate can reset the encoder count to zero. Also, if we get lost, the next passive floor marker plate will re sink the program and update its location.

10. **Can your cart be routed to different destinations?**
    ANS.: A Route Selector may have to be added if the cart does not have an HMI interface. We use what we call a "JUMP" STEP to route the cart left or right from the mainline. Another STEP program feature allows us to change from guiding on the right side of the tape to left. We can use the passive floor marker plates to denote different workstation locations.

11. How sharp of a turn can your cart accomplish?

ANS.: The radius of the turn is dependant on speed, wheel base and heading angle of the steering wheel. One approach is to look at your tightest layout condition and adjust the speed of the cart to safely negotiate the turn. If the wheel base is too long, the steering wheel may turn to sharp on a small radius causing the steering wheel to be pushed off the guidepath. For example, if you have a 25ò wheel base, the turn radius (180°) should NOT be less than 35ò at 90fpm. If the cart is allowed to run at a ñcreepò speed, the smallest radius is whatever radius which keeps the tape in camera view.

12. What happens if there are tape gaps from fork truck or pallets being pushed around?

ANS.: The cart comes with a pre-set factory dead reckoning parameter that determines the size of gap the cart will cross before faulting out. If you have an especially active crossing where the tape continually damaged, the guidepath can be epoxy painted on the floor or the tape can be covered with a clear cover tape to give added protection. Other conditions may allow a dead reckoning over larger gaps (aisles). Your safety group will need to be included in the decision to cross larger gaps.

13. What if the tape gets dirty?

ANS.: Any system requires a certain amount of housekeeping. The guidepath is no different. We suggest putting a clear cover tape over the tape to allow it to be cleaned more often. A floor scrubber can be used or it can be cleaned by hand mop. Our camera system also has an auto-teach feature to reprogram the color stripe if the color changes.

14. How do you repair the tape if it gets damaged and the steering is affected?

Ans.: We suggest cleaning the floor and existing tape with soap and water or whatever will not damage the tape. Lay the new tape over the top of the old tape. The old tape does not have to be removed unless it is all balled up and will prevent the new tape from laying flat.

15. How do we replace the tape if it is not serviceable?

ANS.: First remove a small section of tape. Clean and dry the area thoroughly. A shadow of where the tape was should still be visible. Clean and dry the remaining guidepath to be replaced. Relay the tape and begin to use.

If a shadow of where the tape had been is not visible after cleaning and drying the floor, only remove sections of tape which can be replaced by laying tape between 2 known points.

Remember, the tape is very forgiving if you mess up. Just remove the messed up tape and lay new tape. If you must change the guidepath by more than 10ò to 15ò in a guidepath controlled by a STEP program, you may have to change 2 of the adjacent STEPs to correct the counts between the 2 points. This is a simple task and easily accomplished. We will even help if you are having trouble.

16. Can complex paths be laid out?

ANS.: Yes. Complex layouts can be done and kept very simple with regards to control of the carts. If carts must cross paths, merge or exit a mainline, additional controls or communications may be required. Remember, keep it simple.

17. How do we get a cart to stop "exactly" where we want it to stop?

ANS.: You can get very fancy with a CAD layout and detail it on the floor and lay the tape. The path may still have to be changed to tweak the final cart position and location. We suggest that the time you spend detailing the CAD drawing instead be spent tuning the guidepath on the floor. There will always be dunnage, changes in workstation which were not communicated to you. So, you will have to change the path anyway.

We suggest having a general layout, noting the clearance and safety requirements for cart travel and workstation locations as best known. When the tape ready to be laid, contact all of the workstation owners and get their consensus of where they want a cart to stop and its position regarding access to

parts or the assembly line. Use an actual cart. Drive it to the workstation manually so everyone involved can see how the cart interfaces with operators and dunnage. Use this information to develop the actual path in the workstation. Connect the dots from workstation to workstation. Now, the changes will be minimal.

18. How can the camera see the tape?
ANS.: The cart provides its own modulated light source.

19. How does the cart know when and where to stop?
ANS.: We use inductive proximity switches and passive floor marker plates. The cart controls ignores metal in or on the floor that is smaller than 4ò (nuts and bolts, concrete anchors, etc.). With a 2nd proximity switch, we can make other activities happen at intermediate guidepath locations

20. How does a cart stop at a stop?
ANS.: A cart, controlled by a STEP program, will begin to slow down approximately 20ò before a programmed stop. If the cart is just going from stop-to-stop, then we double the width of tape and the cart will automatically slow down. In both cases, the electronic drive will dynamically brake the drive motor and stop the cart when the stop proximity switch is activated.

21. How does the steering wheel know what direction to turn?
ANS.: The camera follows either the right, left or center of the guidepath tape. A custom camera algorithm analyzes the direction the tape is turning and cart controls command the steering wheel to turn right or left. A steering wheel position sensor knows how far the wheel has turned. The steering wheel will not over steer or create a wheel skid scenario.

22. Will the cart bump into things left in the guidepath?
ANS.: We strongly recommend outlining the profile of the load being carried or towed to gently remind plant people not to set anything in the path of the AGC. If this cannot be done, we provide a pair of ultrasonic sensors which detect ñthingsò out in front of the vehicle. When sensed, the vehicle will slow down and speed back up when the threat disappears. If the threat remains, the cart will come to a stop and wait for someone to clear the obstacle. We will play some annoying music, flash a light and the sensor will beep. The cart will resume normal travel when the obstacle is cleared.

23. If there are obstructions near the path (ex.: a rack structure or a bin), can they be ignored?
ANS.: Several solutions are available. Our cart changes the depth of field of the ultrasonic sensors based on speed: the faster the speed (a wider view)é the further ahead we look or the slower we go (the narrower the view)é the closer to home we look. The speeds can be changed by the end user or the tape width can be modified to slow the cart down. Another approach is to control which ultrasonic sensor is active. The cart controls can be modified by the end user such that when the cart is turning right, only the left sensor is active until the cart straightens out after the turn and vice versa. This enables a cart to effectively turn around a column and still have a cone of obstacle protection covering the front of the vehicle.

24. Are the ultrasonic sensors safety rated?
ANS.: No they are not safety rated. Safety rated laser scanners can be provided. They are quoted separately. If laser scanners are used, normally, a flexible bumper is not provided. The laser scanner has multiple programs controlling 2 zones: a warning zone and a safety zone.

25. Can flexible bumpers be used as a safety device?
ANS.: Yes, as long as a dual channel safety relay is applied along with 2 safety rated sensors which monitor the bumper movement. Each sensor has to be wired to a separate input. Usually, a flexible safety bumper will be used with some other collision avoidance sensor.

26. Are there other safety features required or supplied?
ANS.: We provide an Emergency Stop button. An additional E-Stop button can be provided and can be quoted as an option. Wide load protection can be provided if the end user requests a means to protect a

load which protruded beyond the edges of the cart. Side protection and rear bumpers can also be quoted if required.

27. Does the cart have load present sensors?

ANS.: Depending on the product being carried and the level of information the end-user requires, we can provide proximity switches or a 24vdc photo eye. Other options are available and maybe product specific. If a product, such as a pallet, is placed on the cart deck, we suggest using 2 sensors to help insure the rack has been placed on the cart and is resting level on the deck.

28. Can off-board controls be used to release the cart from a stop?

ANS.: Yes, there a variety of sensors, flags and devices that can be used to release the cart. They can be as simple as a traffic cone placed in front of the vehicle to stop and re start the cart. Or, they can be a series of interlocks, cart signals, torque tool signals and other traffic control signals.

29. How is a disabled cart recovered from an assembly line or moved off-line for service?

ANS.: Manual recovery of the cart is very simple. We do not require having a handle to lift a wheel or a motor to lift the drive and steering wheel(s) from the floor. Our manual recovery feature will continue to move the deck load or trailer train or tunnel slave cart. A simple 3 position selector switch provides steering and a 2 position auto/manual selector switch provides the service mode. The cart will drive, in creep mode, with the operator attending the cart and steering with the selector switch.

30. How can we diagnose a cart problem?

ANS.: The first and most useful method to diagnose a cart problem is to train the operators to not to become complacent with the carts moving about them. If they can be your eyes and ears on the floor, their input will quickly lead to the problem.

A basic cart uses the running light and the melody module to display and enunciate codes which provide diagnostics. An upper level cart which will probably have a HMI display which can display codes. Another way to check cart status is to view the setup screens to make sure the cart is setup correctly. The Operation and Maintenance manual will provide in-depth diagnostic information including some multi-meter readings.

31. How long will the batteries last?

ANS.: Good question! *Battery chemistry is science but battery charging is an art form.* There are many factors affecting battery ñlifeò such as: length of guidepath, live load, number of charge cycles the battery has experienced, depth of discharge, length of charge, type of charger and voltage drop from charger to batteries. The battery pack (MK GEL or OPTIMA AGM) has been tested to last at least 8 to 10 hours at maximum rated speed, 3 foot radius turns, full battery pack and at maximum live load, on our test track. The battery tests are run continuously and also with 2 in the middle of the long leg of our test track. Field conditions at your facility will probably be different and may affect the battery ñlifeò

We will try to help qualify your application to provide the best and most economical battery and charging application for your system.

32. Why is there a RUN and SERVICE position on the back of the cart?

ANS.: The fail-safe brake lever has 2 positions: RUN and SERVICE. RUN is part of the drive enabling circuit and the lever must be in the RUN position to start the drive motor. The SERVICE position allows you to manually push the cart for positioning it over the tape or for removing it from the active production line to an out-of-service location.

33. Why is there a fail-safe brake on the drive motor?

ANS.: The fail-safe brake activates when the Emergency Stop button is pushed or the flexible bumper is collapsed. The cart will stop immediately.

We also use the fail-safe brake to as a parking brake when the cart is stopped.