



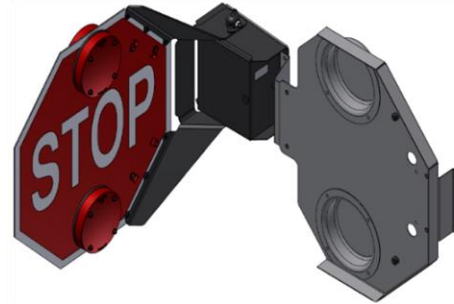
# -Defender Electric Stop Arms -HDX Air Crossing Arm

December 2016

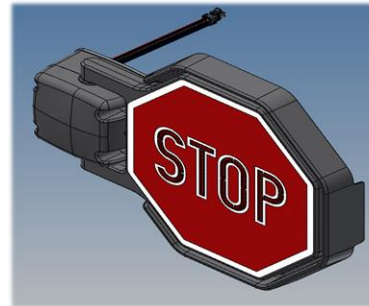


# Products

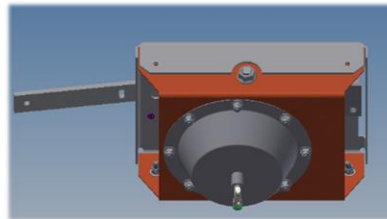
- Defender Electric Stop Arm



- Defender Composite Stop Arm



- Thomas HDX Air Cross Arm



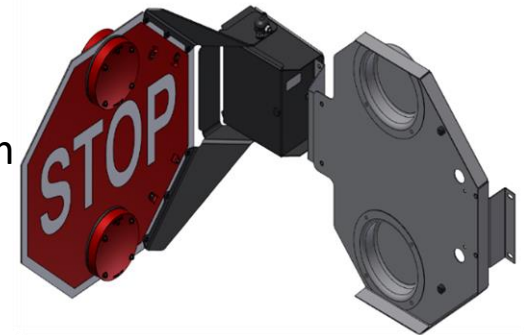
# Defender Electric Stop Arm

## What is changing

- All current 7 Series electric stop arms

## Why is it changing

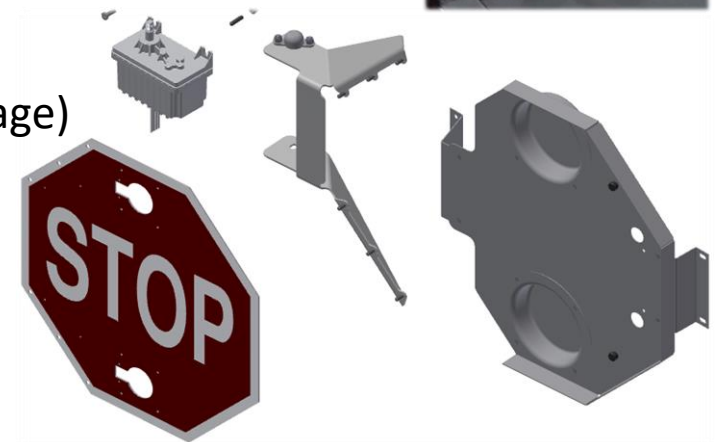
- Reduce warranty costs associated with motor failure.
- Improve product reliability and functionality.
- Integrate Safe Fleet's next generation stop arm/crossing arm drive system.
- 7 Series SA based on old (1980's) stop arm design and bus application
  - Buses traveled at slower speeds
  - Bus body less aero, different air flow around bus and stop arm
- Motor failures due wind flutter and continuous run
- High warranty cost
- Customer expectation of longer warranty and life expectancy



# Defender Electric Stop Arm

## How is changing

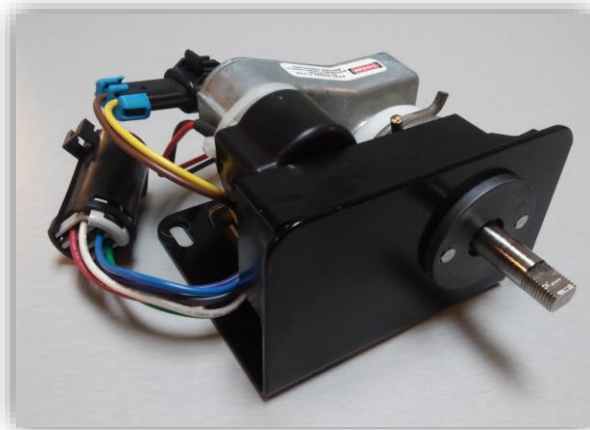
- New motor
  - Obstruction detection to eliminate continuous run condition
  - 200% plus increase in motor torque to reduce wind flutter
  - Encoder based position control with self homing routine
  - Passive breaking function improves blade/rod retention
- Steel cast blade driver keyed to motor shaft with set screw
- New heavy duty hinge and blade design
- Blade is 30% thicker
- Tested to 350,000+ cycles (10-12 years average usage)
- Three year warranty
- New optional high wind guard



# Defender Stop Arm Changes - Motor

## Motor

- Applicable to Specialty & Transpec Stop Arms
- Increased output torque from 150 in·lb to 350 in·lb
- Part count reduction and decreased maintenance
- Passive braking system for improved resistance to wind flutter
- Integrated closed loop controller with motor encoder to improve deployment accuracy
- Obstruction detection to prevent blade damage and improve safety



**Current Design**



**New Design**

# Defender Stop Arm Changes Hinge Arm / Wind Guard / Blade

## Hinge Arm / Windguard

- Heavier gauge with simultaneous weight reduction
- Increased bend radii to prevent premature fatigue failures
- Single piece component with radius edges to improve strength and aesthetics

## Blade

- Increased thickness by 30% to prevent premature fatigue failures



**Current Design**

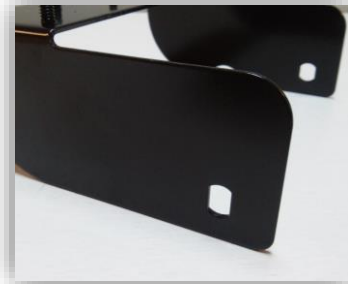


**New Design**

# Defender Stop Arm Changes – Blade Driver

## Blade Driver

- Steel investment cast driver with key extending full length of shaft and set screw
- This allows for reduced backlash in the blade improving deployment accuracy
- Redundancy in the attachment point



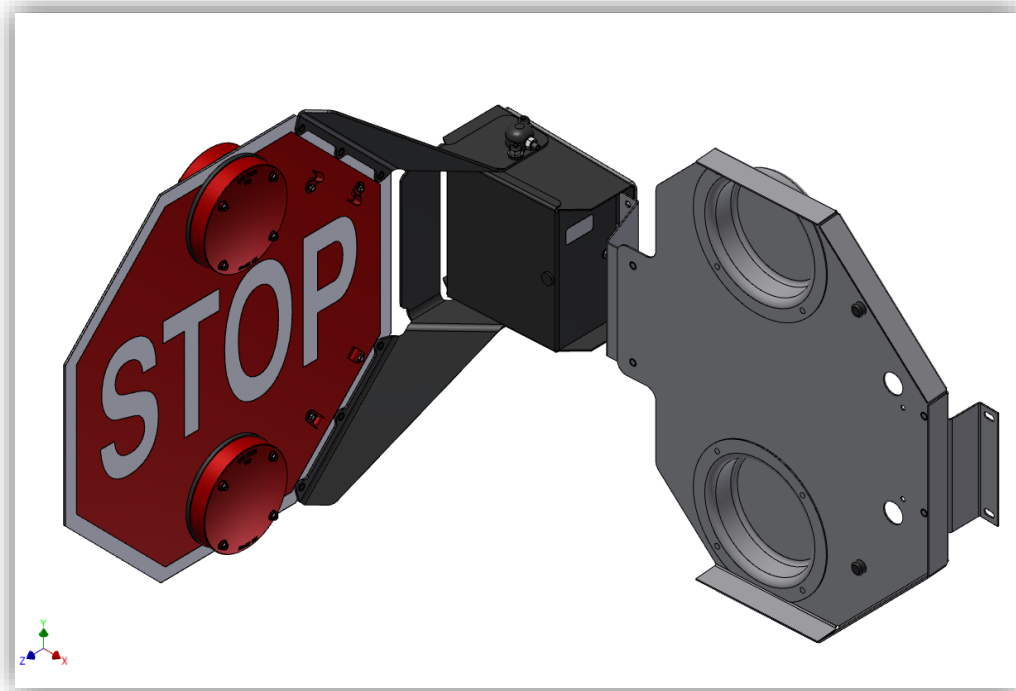
Current Design

New Design

# Defender Stop Arm Changes – High Wind Guard Option

High Wind Guard

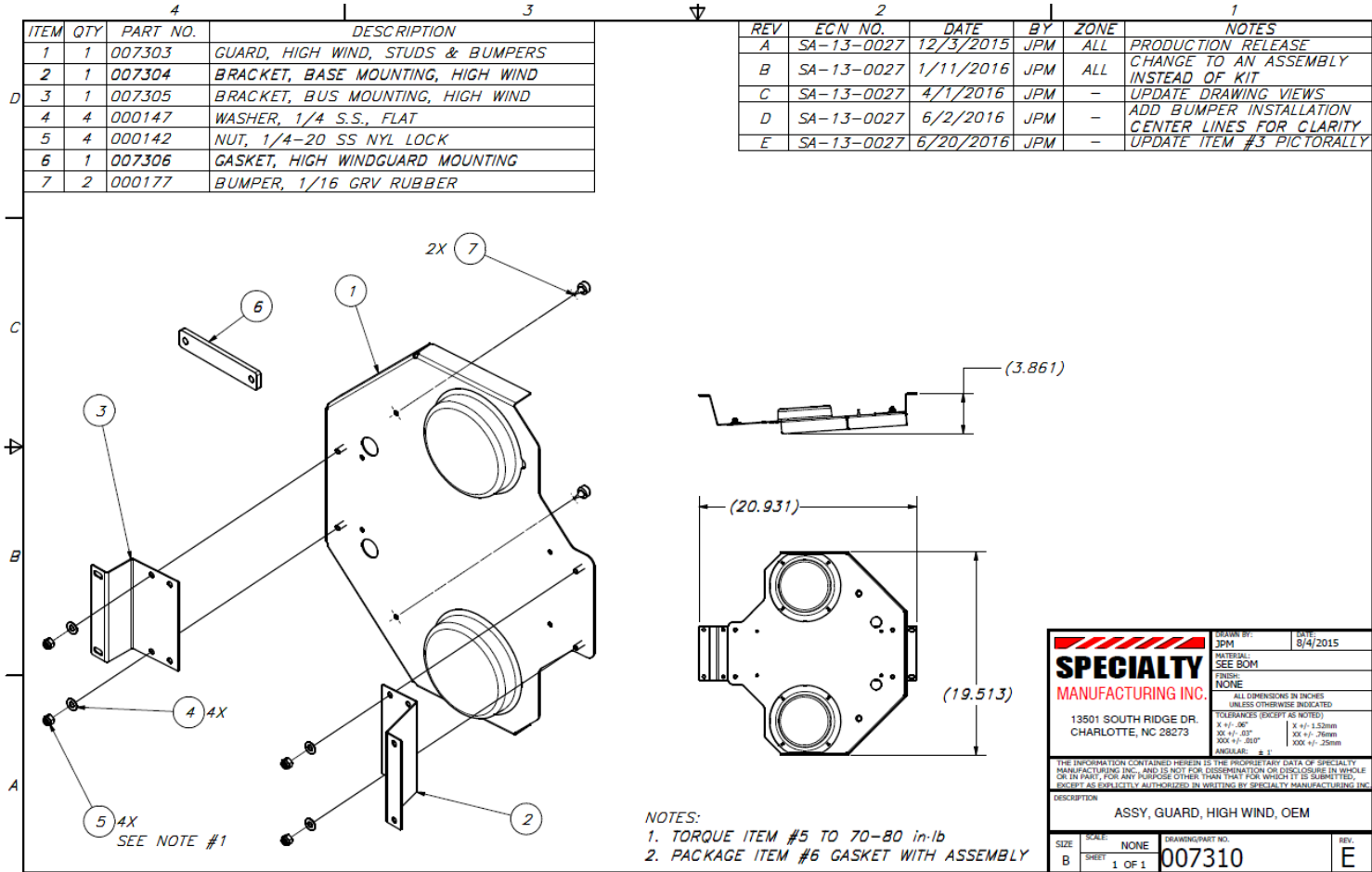
- Optional





# Defender Stop Arm Changes – High Wind Guard Option

## High Wind Guard Option – complete assembly



# Production Part Numbers / Prices - Complete Assemblies

Thomas Bus - Safe fleet NEW Defender Pricing, complete assemblies

11/29/2016

(CP = Carton Pack of 3)

(SP = Single Pack, service only)

Current SF Part #	Current TBB Part #	New SF PN	New SF PN (Non racked parts)	New SF PN (Racked parts)	New SF PN OES	New TBB OEM Part #	New TBB/DTNA OES Part #	Description
007500	166755	SE1-7500	SE17500-CP	SE17500-RK	SE17500-SP			Defender S/A-,REFL BLD W/LTS
007500C	166767-K	SE1-7500-C	SE17500C-CP	SE17500C-RK	SE17500C-SP			Defender S/A-,REFL BLD W/LTS, C2
007501	166756	SE1-7501	SE17501-CP	SE17501-RK	SE17501-SP			Defender S/A-,REFL BLD W/LTS, RR-MT
007501C	166768-K	SE1-7501-C	SE17501C-CP	SE17501C-RK	SE17501C-SP			Defender S/A-,REFL BLD, RR MT W/LTS, C2
007504	166757	SE1-7504	SE17504-CP	SE17504-RK	SE17504-SP			Defender S/A-,REFL BLD W/LTS, ARRET
007504C	166758-K	SE1-7504-C	SE17504C-CP	SE17504C-RK	SE17504C-SP			Defender S/A-,REFL BLD, ARRET W/LTS, C2
								Defender S/A-,REFL BLD W/LTS ,FLASHER
007900	166759	SE1-7900	SE17900-CP	SE17900-RK	SE17900-SP			Defender S/A-,HI INT BLD W/LTS
007901	166760	SE1-7901	SE17901-CP	SE17901-RK	SE17901-SP			Defender S/A-,HI INT BLD W/LTS, RR MT
								Defender S/A-,HI INT BLD, ARRET W/LTS, C2
007970	166762	SE1-7970	SE17970-CP	SE17970-RK	SE17970-SP			Defender S/A-,HI INT BLD W/ NON-STRB LED
007970C	166770-K	SE1-7970-C	SE17970C-CP	SE17970C-RK	SE17970C-SP			Defender S/A-,HI INT BLD W/ NON-STRB LED, C2
								Defender S/A-,HI INT BLD, NON-STB LED,RR
007971C	167698-K	SE1-7971-C	SE17971C-CP	SE17971C-RK	SE17971C-SP			Defender S/A-,HI INT BLD, NON-STB LED,RR, C2
007980	166764	SE1-7980	SE17980-CP	SE17980-RK	SE17980-SP			Defender S/A-,HI INT BLD, STROBING LED
007980C	166771-K	SE1-7980-C	SE17980C-CP	SE17980C-RK	SE17980C-SP			Defender S/A-,HI INT BLD, STROBING LED, C2
007981	166765	SE1-7981	#N/A	SE17981-RK	#N/A			Defender S/A-,HI INT BLD ,STRB LED, RR
007981C	167699-K	SE1-7981-C	SE17981C-CP	SE17981C-RK	SE17981C-SP			Defender S/A-,HI INT BLD ,STRB LED, RR, C2

Product	Current Safe Fleet #	Current Thomas #	Description	Comments	New Safe Fleet #	New Thomas #
Defender Electric, Incandescent Lights	SE17500C-RK	209045	ELEC S/A, DEF, ENG, 2-LT INCAN, C2	Motor Change Only	SE27500C-RK	221075
	SE17500-RK	209024	ELEC S/A, DEF, ENG, 2-LT INCAN		SE27500-RK	221082
	SE17501C-RK	209046	ELEC S/A, DEF, ENG, INCAN, C2, REAR		SE27501C-RK	221076
	SE17501-RK	209025	ELEC S/A, DEF, ENG, REAR, 2-LT INCAN		SE27501-RK	221083
	SE17504C-RK	209044	ELEC S/A, DEF, ENG, ARRET, 2 LT INCAN, C2		SE27504C-RK	221074
	SE17504-RK	209026	ELEC S/A, DEF, ENG, ARRET, 2-LT INCAN		SE27504-RK	221084
	SE17900-RK	209027	ELEC S/A, DEF, HI-INT, 2-LT INCAN		SE27900-RK	221085
	SE17901-RK	209028	ELEC S/A, DEF, HI-INT, REAR, 2-LT INCAN		SE27901-RK	221086
Defender Electric, LED Lights	SE17970C-RK	209047	ELEC S/A, DEF, HI-INT, FLASH LED, 3 PIN	LED Light/ Flasher and Motor Change	SE27970C-RK	221077
	SE17970-RK	209029	ELEC S/A, DEF, HI-INT, 2 LT FLASH LED		SE27970-RK	221087
	SE17971C-RK	209048	ELEC S/A, DEF, HI-INT, REAR, FLSH LED, C2		SE27971C-RK	221078
	SE17980C-RK	209049	ELEC S/A, DEF, HI-INT STRB LED, 3 PIN		SE27980C-RK	221079
	SE17980-RK	209031	ELEC S/A, DEF, HI-INT, 2 LT STRB LED		SE27980-RK	221088
	SE17981C-RK	209050	ELEC S/A, DEF, HI-INT, REAR, STRB LED, C2		SE27981C-RK	221080
	SE17981-RK	209032	ELEC S/A, DEF, HI-INT, REAR, 2 STRB LED		SE27981-RK	221089
Air Stop Arm, LED Lights	002970/0113	65012186	S/A-AIR, HI-INT W/NON-STRB LED	LED Light/ Flasher	SA12970/0113-SP	222434
	002970C	130314-K	S/A-AIR, HI-INT W/NON-STRB LED,		SA12970C-SP	222429
	002971/0113	65012187	S/A-AIR, HI-INT, NON-STB LED, RR		SA12971/0113-SP	222435
	002971C	138704-K	S/A-AIR, HI-INT, NON-STB LED, RR		SA12971C-SP	222430
	002980/0113	65012190	S/A-AIR, HI-INT W/STROBING LED		SA12980/0113-SP	222436
	002980C	167690-K	S/A-AIR, HI-INT W/STRB LED, C2		SA12980C-SP	222431
	002981/0113	65012191	S/A-AIR, HI-INT W/STRB LED, RR MOUNT		SA12981/0113-SP	222437
	002981C	167692-K	S/A-AIR, HI-INT W/STRB LED, RR-M, C2		SA12981C-SP	222432
	002984C	150267-K	S/A-AIR, HI-INT W/STRB LED, ARRET, C2		SA12984C-SP	222433

# New Electric Stop Arms - LED

Electric Stop Arm LED Upgrade Matrix					All three complements needed for upgrade			Complete New Stop Arm		
SE1 Series	7 Series	Description	TBB - OEM	TBB - OES	LED, LIGHT KIT	New Harness	Connector	SF Part Number	TBB Part Number	DTNA Part Number
SE17970-XX	007970	ELEC S/A, DEF, HI-INT, 2 LT FLASH LED	209029	TBB 209029	000295K	007438	None	SE27970-SP	221087	
SE17970C-XX	007970C	ELEC S/A, DEF, HI-INT, FLASH LED, 3 PIN	209047	TBB 209047	000295K	007436	42-039	SE27970C-SP	221077	TBB 221077
SE17970D-XX	007970D	ELEC S/A, DEF, HI-INT, FLASH LED, 3 PIN		SMA SE1 7970D SP	000295K	007429	005053	SE27970D-SP		
SE17970E-XX	007970E	ELEC S/A, DEF, HI-INT, FLSH LED, 6 PIN			000295K	007440	42-046	SE27970E-SP		
SE17971-XX	007971	ELEC S/A, DEF, HI-INT, REAR, FLASH LED		SMA SE17971SP	000295K	007438	None	SE27971-SP		
SE17971C-XX	007971C	ELEC S/A, DEF, HI-INT,REAR,FLSH LED, C2	209048	TBB 209048	000295K	007436	42-039	SE27971C-SP	221078	TBB 221078
SE17971D-XX	007971D	ELEC S/A, DEF, HI-INT, REAR, FLASH LED			000295K	007429	005053	SE27971D-SP		
SE17974-XX	007974	ELEC S/A, DEF, HI-INT, ARRET, FLSH LED			000295K	007438	None	SE27974-SP		
SE17974D-XX	007974D	ELEC S/A, DEF, HI-INT, ARRET, FLASH LED			000295K	007429	005053	SE27974D-SP		
SE17980-XX	007980	ELEC S/A, DEF, HI-INT, 2 LT STRB LED	209031	SE17980SP	000297K	007438	None	SE27980-SP	221088	TBB 221088
SE17980C-XX	007980C	ELEC S/A, DEF, HI-INT STRB LED, 3 PIN	209049	TBB 209049	000297K	007436	42-039	SE27980C-SP	221079	TBB 221079
SE17980D-XX	007980D	ELEC S/A, DEF, HI-INT, STRB LED, GROMET			000297K	007429	005053	SE27980D-SP		
SE17980E-XX	007980E	ELEC S/A, DEF, HI-INT, STRB LED, 6 PIN			000297K	007440	42-046	SE27980E-SP		
SE17980EL-XX	007980EL	ELEC S/A, DEF, HI-INT,STRB LED,35" 6 PIN			000297K	007441	42-046	SE27980EL-SP		
SE17981-XX	007981	ELEC S/A, DEF, HI-INT, REAR, 2 STRB LED	209032	TBB 209032	000297K	007438	None	SE27981-SP	221089	TBB 221089
SE17981C-XX	007981C	ELEC S/A, DEF, HI-INT,REAR,STRB LED, C2	209050	TBB 209050	000297K	007436	42-039	SE27981C-SP	221080	TBB 221080
SE17981D-XX	007981D	ELEC S/A, DEF, HI-INT, REAR,STRB LED			000297K	007429	005053	SE27981D-SP		
SE17981E-XX	007981E	ELEC S/A, DEF, HI-INT,REAR,STRB LED,6 PIN			000297K	007440	42-046	SE27981E-SP		

XX is a place holder for packaging and could be, -CP, -RK, -SP



# New Air Stop Arms - LED

Air Stop Arm LED Upgrade Matrix				All three complemts needed for upgrade			Complete New Stop Arm			
Old Part Number	Description	TBB - OEM	TBB - OES	LED, Light Kit	New Harness	Connector	SF Part Number	TBB Part Numbner	DTNA Part Number	
002970	S/A-AIR,HI-INT W/NON-STRB LED			000291K	002156	None	SA12970-SP			
002970/0113	S/A-AIR,HI-INT W/NON-STRB LED	65012186	TBB 65012186	000291K	002156	None	SA12970/0113-SP	222434	TBB 222434	
002970B	S/A-AIR,HI-INT W/NON-STRB LED			000291K	002158	None	SA12970B-SP			
002970C	S/A-AIR,HI-INT W/NON-STRB LED,	130314-K	TBB 130314	000291K	002159	42-039	SA12970C-SP	222429	TBB 222429	
002970D	S/A-AIR,HI-INT W/NON-STRB LED, GROMMET			000291K	002155	005053	SA12970D-SP			
002970R	S/A-AIR,HI-INT W/NON-STRB LED, RT-RR			000291K	002156	None	SA12970R-SP			
002971	S/A-AIR,HI-INT,NON-STB LED,RR			000291K	002156	None	SA12971-SP			
002971/0113	S/A-AIR,HI-INT,NON-STB LED,RR	65012187	TBB 65012187	000291K	002156	None	SA12971/0113-SP	222435	TBB 222435	
002971B	S/A-AIR,HI-INT,NON-STB LED,RR			000291K	002158	None	SA12971B-SP			
002971C	S/A-AIR,HI-INT,NON-STB LED,RR	138704-k	TBB 138704	000291K	002159	42-039	SA12971C-SP	222430	TBB 222430	
002971D	S/A-AIR,HI-INT, NON-STB LED,RR,GROMMET			000291K	002155	005053	SA12971D-SP			
002974B	S/A-AIR,HI-INT,NON-STB LED,ARR			000291K	002156	None	SA12974B-SP			
002974	S/A-AIR,HI-INT,NON-STB LED,ARR			000291K	002156	None	SA12974-SP			
002974D-CP	S/A-AIR,HI-INT,NON-STB LED,ARRET, GROMM			000291K	002155	005053	SA12974D-SP			
002980	S/A-AIR,HI-INT W/STROBING LED			000292K	002156	None	SA12980-SP			
002980B	S/A-AIR,HI-INT W/STB LED,BBIRD			000292K	002158	None	SA12980B-SP			
002980C	S/A-AIR,HI-INT W/STRB LED,C2	167690-k	SMA 2980C	000292K	002159	42-039	SA12980C-SP	222431	TBB 222431	
002980D	S/A-AIR,HI-INT W/STROBING LED, GROMMET			000292K	002155	005053	SA12980D-SP			
002980E	S/A-AIR,HI-INT W/STROBING LED, SPL CONN			000292K	002157	42-046	SA12980E-SP			
002980/0113	S/A-AIR,HI-INT W/STROBING LED	65012190	TBB 65012190	000292K	002156	None	SA12980/0113-SP	222436	TBB 222436	
002981	S/A-AIR,HI-INT W/STRB LED,RR-M			000292K	002156	None	SA12981-SP			
002981/0113	S/A-AIR,HI-INT W/STRB LED,RR MOUNT	65012191	TBB 65012191	000292K	002156	None	SA12981/0113-SP	222437	TBB 222437	
002981B	S/A-AIR,HI-INT W/STRB LED,RR-M			000292K	002158	None	SA12981B-SP			
002981C	S/A-AIR,HI-INT W/STRB LED,RR-M, C2	167692-K	TBB 167692	000292K	002159	42-039	SA12981C-SP	222432	TBB 222432	
002981D	S/A-AIR,HI-INT W/STRB LED,RR-M, GROMMET			000292K	002155	005053	SA12981D-SP			
002981E	S/A-AIR,HI-INT W/STRB LED,RR MNT			000292K	002157	42-046	SA12981E-SP			
002984	S/A-AIR,HI-INT W/STRB LED,ARRET			000292K	002156	None	SA12984-SP			
002984C	S/A-AIR,HI-INT W/STRB LED,ARRET,C2	150267-k	TBB 150267	000292K	002159	42-039	SA12984C-SP	222433	TBB 222433	
002984D	S/A-AIR,HI-INT W/STRB LED,ARRET, GROMMET			000292K	002155	005053	SA12984D-SP			
002984E	S/A-AIR,HI-INT W/STRB LED,ARRET			000292K	002157	42-046	SA12984E-SP			
002985D	S/A-AIR,HI-INT W/STRB LED,ARRET, RR MOUNT, GROMMET			000292K	002155	005053	SA12985D-SP			
002985E	S/A-AIR,HI-INT W/STRB LED,ARRET, RR MOUNT, GROMMET			000292K	002157	005053	SA12985E-SP			

# Service Part Numbers / Prices – Sub Components

New SF PN	Description	
<b>Major Parts</b>		
007175	MOTOR- S/A, X/A	
007183	ARM, HINGE, WINDGUARD - PAINTED	
007194	LOCK, HINGE ARM, ECOAT AND PAINT	
007312	KIT, GUARD, HIGH WIND, AFTER-MARKET	
SE178106	ASSY - DEF, BASE, QK DISCNCT	
SE178106C	ASSY - DEF, BASE, QK DISCNCT	
SE178106D	ASSY - DEF, BASE, QK DISCNCT	
SE178106E	ASSY - DEF, BASE, QK DISCNCT	
<b>Blade / Decal / Hinge Arm</b>		
007180-7k	BLADE, ENG, W/ LT HOLES	
007181-7k	BLADE, HI-INT, W/ LT HOLES	
007184-7k	BLADE, ENG, REAR, W/ LT HOLES	
007185-7k	BLADE, HI-INT, REAR, W/ LT HOLES	
007186-7k	BLADE, ENG, ARRET, W/ LT HOLES	
007182-7k	BLADE, HI-INT, ARRET, W/ LT HOLES	
<b>Blade and Decal</b>		
000548	DECAL, ENG, W/ LT HOLES	
000948	DECAL, HI-INT, W/ LT HOLES	
000446	DECAL, SOLID RED, W/ LT HOLES	
000949	DECAL, HI-INT, ARRET, W/ LT HOLES	
<b>Misc Part s</b>		
007197	BUSHING- MOLDED	
T2100-B	SCREW - SPECIAL TORX HI/LO W/ZINC BLACK	

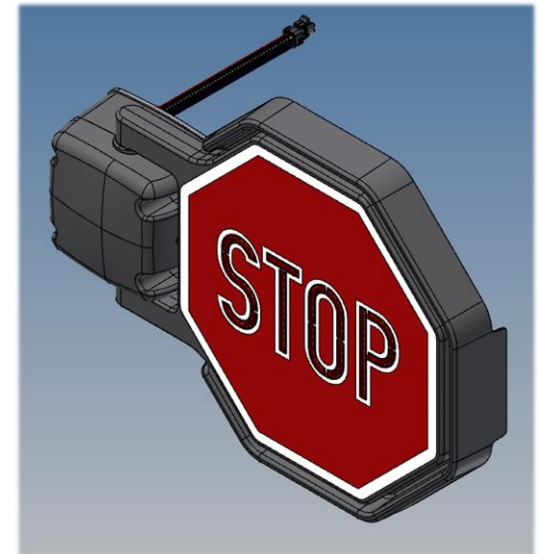
# Defender Composite Stop Arm

## What is changing

- Replaces all Transpec composite stop arms

## Why is it changing

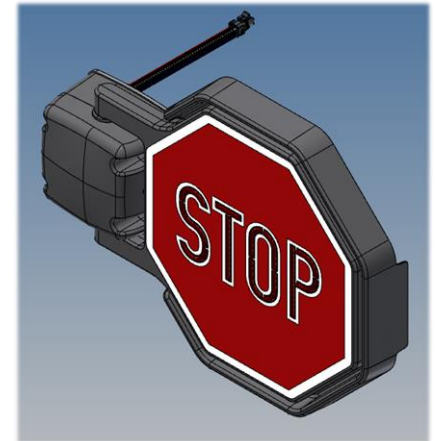
- Injection molded tooling is at end of life – primary reason
- Tooling update created the opportunity to
  - Update the design and address existing issues
  - Intergrade new motor



# Defender Composite Stop Arm

## How is changing

- New motor
  - Obstruction detection to eliminate continuous run condition
  - 200% plus increase in motor torque
  - Encoder based position control with self homing routine
  - Passive breaking function improves blade/rod retention
- Updated design
  - New wind guard
  - New updated look
  - New metal driver and follower
- Tested to 350,000 cycles (10+ years average usage)
- Three year warranty
- Wind guard and motor changes eliminate the need for the servo-latch

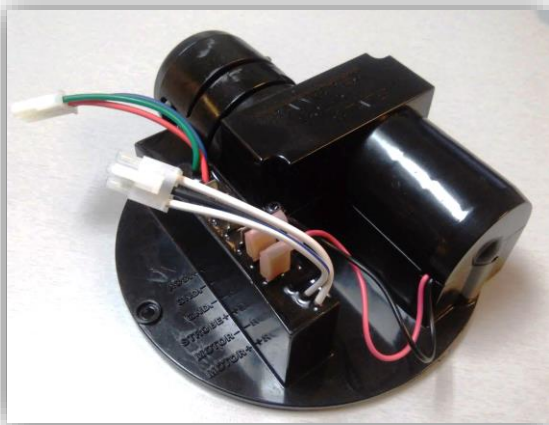




# Defender Composite Stop Arm Design Changes

## Motor

- Applicable to Specialty & Transpec Stop Arms
- Torque output increased to 350 in·lb
- Part count reduction and decreased maintenance
- Passive braking system
- Integrated closed loop controller with motor encoder to improve deployment accuracy
- Obstruction detection to prevent blade damage and improve safety



**Current Design**

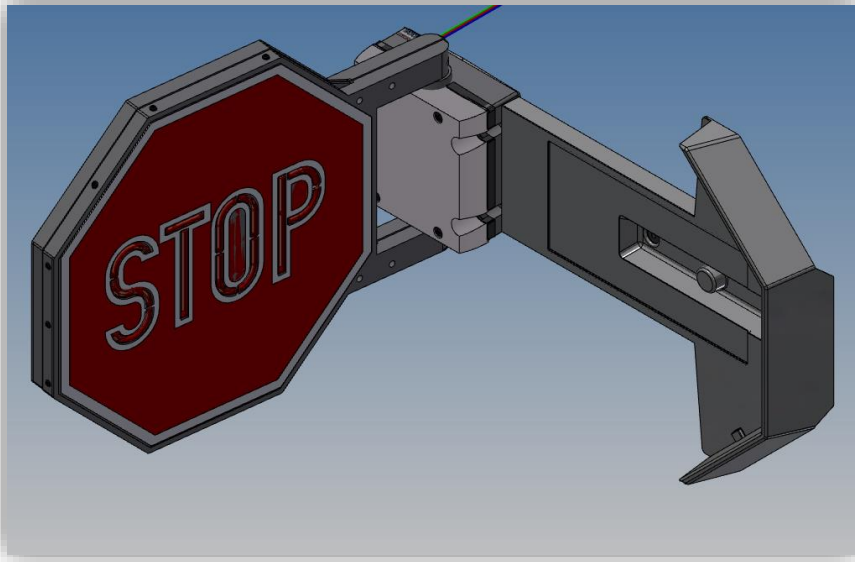


**New Design**

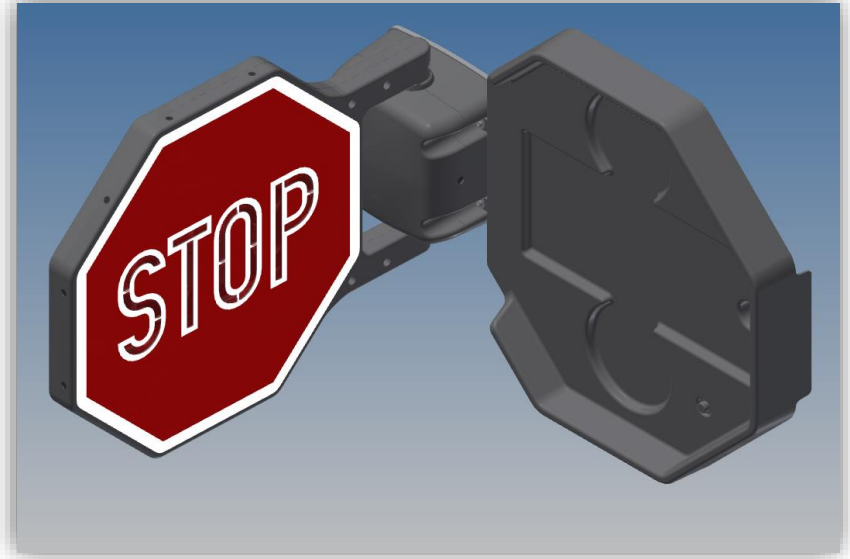
# Defender Composite Stop Arm Design Changes

## Windguard

- New windguard covers entire rear surface of blade to reduce air flow behind blade and prevent wind flutter



Current Design



New Design

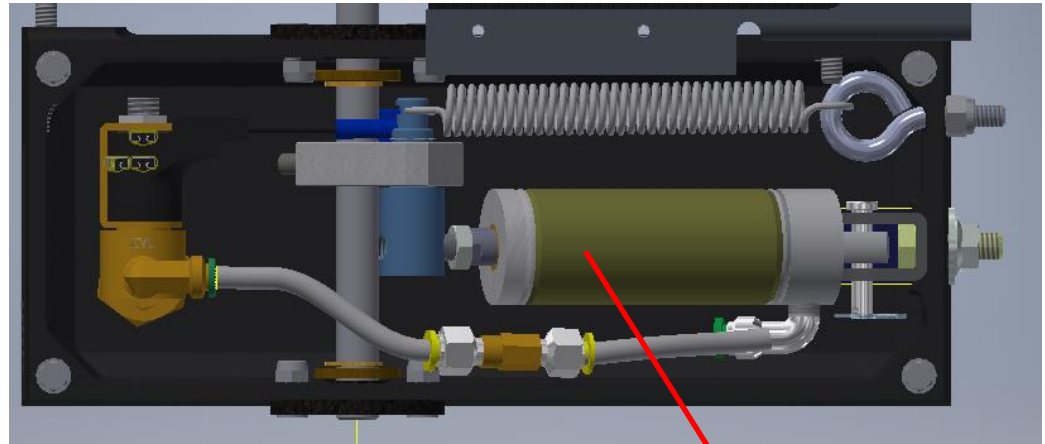
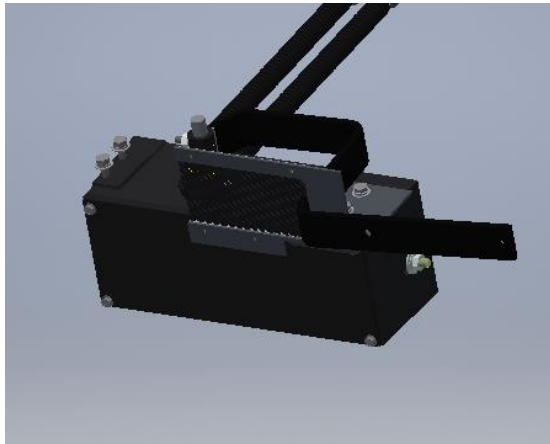
# Defender Composite Launch Timing

- March
  - Transpec complete Stop Arms no longer available after 3/1/17
- Transpec service parts will still be available

# HDX Air Crossing Arm Base

Current PN 179655 / 028139

- Current HDX Air Cross Arm Function
  - The HDX design uses a pneumatic cylinder to drive the rotation of the polyrod.
  - In the past, the HDX design had issues withstanding intense vibration as well as inconsistent movement of the arm which ultimately resulted in shorter polyrod life.
  - As a result the HDX design was redesigned to improve the inner components and the overall strength of the polyrod.
  - However, it appears, achieving a smoother operation has led to a slower than desired movement in some extreme wet conditions. We believe this is a result of a need for more rotation energy to overcome the friction of the system during wet conditions).
  - The increased energy could be achieved by more input (bigger cylinder, more air psi) or more output (reduced system friction, increased leverage of the arm). The dimensional constraints of the vehicle as well as the constraints of the unit's housing limits the effectiveness of any of these improvements.

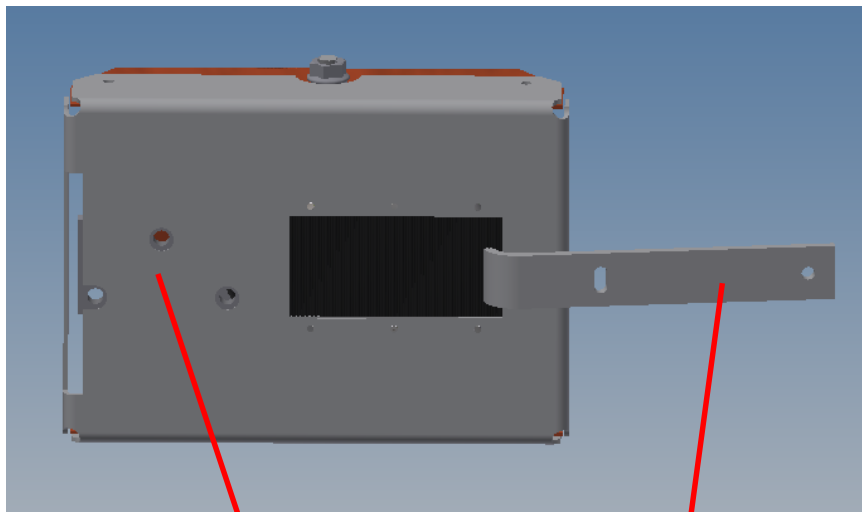


Air Cylinder

# Proposed Air HDX Design (New PN XA1-28139 / 209023)

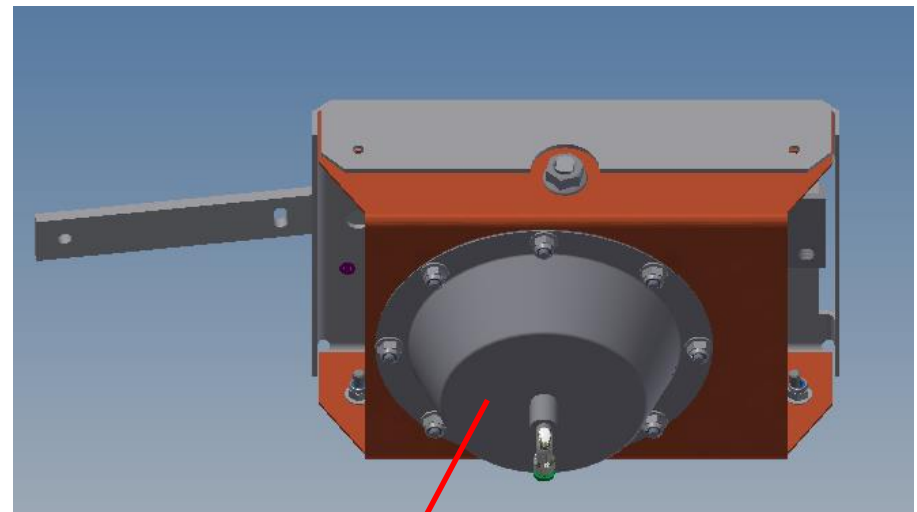
The proposed HDX design would:

- Use the same air diaphragm mechanism as the C2 design
- Provide more power and consistency to the rotation of the polyrod during extreme conditions
- Appear on the (outside of the bus) to be the same as the current design
- Be easily replaced in the field for the current HDX design
- Use the same 186119 polyrod (028213) as the current design



Cover has same bolt pattern as current HDX design

Bent Flat Bar (same as current HDX)



Air Diaphragm

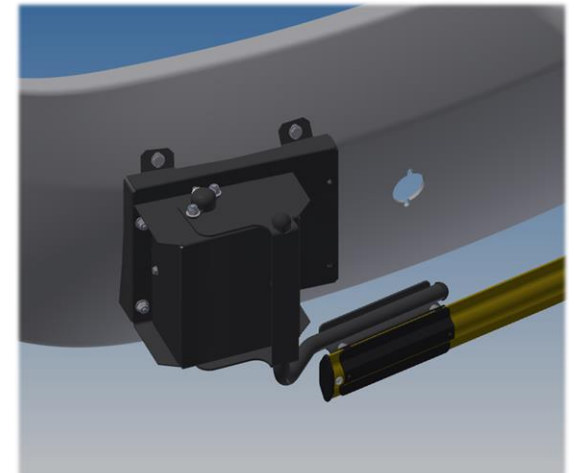
# Defender Electric Cross Arm (Fall 2017)

## What is changing

- All current 7 Series electric cross arms
- Both C and D types

## Why is it changing

- Reduce warranty costs associated with motor failure
- Improve product reliability and functionality
- Integrate Safe Fleet's next generation stop arm/crossing arm drive system.



# Defender Electric Cross Arm

## How is changing

- New motor
  - Obstruction detection to eliminate continuous run condition
  - 200% plus increase in motor torque to reduce wind flutter
  - Encoder based position control with self homing routine
  - Passive breaking function improves blade/rod retention
- New welded hinge arm and welded clam shell rod attachment (BB)
- Designed for use with improved rod introduced of June 2016 (BB)
- Tested to 350,000 cycles (10+ years average usage)
- Warranty increased from two to three years

