

# **C4i** **ROBOTICS**

**NON-DESTRUCTIVE TESTING  
SOLUTIONS AND TECHNOLOGIES**



## **C4I-RPAS**

**Robotic Cleaning and Paint (Attachment) System**

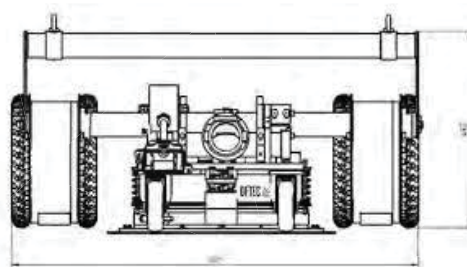
## Robotic Cleaning and Paint (Attachment) System (RPAS)

This Crawler is a device that will stick to the vertical above ground metal storage tanks, by a strong magnet, cleaning and de-coating using a rotating, very high pressure, water jet arm and collecting the debris using strong suction. The Crawler is remotely operated from the base of the tank. The debris is guided to a couple of filters, so that the water can be safely and legally exposed off, or reused. The de coated area will be dry and ready for (re) coating

### Objective:

The objective is to add a paint function to the Crawler, so the crawler can perform both de-coating and painting during the same cycle.

Since the de-coating function of the crawler is clean, and leaves a dry surface, behind the crawler, placing a Paint module on the crawler will save time and money.



### General description

The RPAS would be a Customized, complete and attachable system.

The RPAS consists of the following parts:

- Paint Applicator (Paint Frame; Attachment; Nozzle; Powered arm; Valves)
- Umbilical's (Hoses; Electric cable; Jacket; Terminations)
- Camera system (camera; bracket; Cable; Lens protector; controller)
- Paint controller (Steel Cart/Lorry; Paint mixer; Paint container; Compressor; Power supply; Valves)

The RPAS will be attached to the back of the Crawler, this to prevent that the crawler moves over the fresh paint. Also, the back of the Crawler provides a better opportunity for an attachment.

The attachment will be adjustable, to make the system more flexible and can be moved easily during transport and mobilizing of the Crawler

The RPA can be connected and disconnected to the Crawler attachment, within minutes.

The Paint applicator will be a Stainless Steel window, to guide the applicator arm and nozzle  
This whole window can be angle adjusted.

This Paint applicator will be connected to a bracket with the termination of the Umbilical

This umbilical can be guided away from the Crawler strapped to the Crawlers Pressure/Vacuum hose.



The Camera system will consist of minimal one, optimally two cameras. The camera will be located above and away from the Paint nozzles. One camera at the back of the Crawler and one in front. With these two cameras, footage can be provided of the pain job, and / or as quality assessment. The lens protector will be such that the paint, reflected off of the paint applicator, will be kept away from the camera lens.

#### *Paint controller.*

The paint controller is a Steel Cart/Lorry, on wheels/casters that can be moved, at the base of the tank, following the Crawler. This lorry carries the Power supply, supplying power to the Hydraulics, Cameras, Paint mixers, Compressor (to move the paint from the lorry to the applicator) and controls. We will detail the wheels, size and shape of the lorry, as these are important to the operational effectiveness of the overall system. The Robot Operator, or an additional Operator, will have control over the RPAS. Through a remote controller the operator can start and stop the paint flow. The Paint applicators movements can be controlled from the Controller.

We collected and received the following info on the Paint to be used:

#### **Paint:**

Two component, polyamine cured, phenolic/novolec epoxy coating.

Product mixing: by weight: Component A: 6.5 Parts

Component B: 1 Part

Thinner: Jotun Thinner # 23

Color: Light grey (Optional: Light red and red)

Typical dry film thickness: 0.150 millimeters

Method: Airless Spray

Nozzle tip: (inch/1000): 17-21

Pressure at nozzle (Minimal): 150 bar/2100 psi

Typical dry time: 4 hours to 24 hours (Advised is 24 hours)

Dried/cured for service: 21 days

Induction time is 20 minutes

Pot life is 4 hours

Shelf life at 23 Deg C is 2 years

#### **Attachment to the Crawler:**

We believe that the best spot to mount the RPAS paint applicator is at the back of the Crawler.

This to prevent the wheels, on the left and right of the Crawler, to move over the paint and to locate the applicator next to the previous pass through.

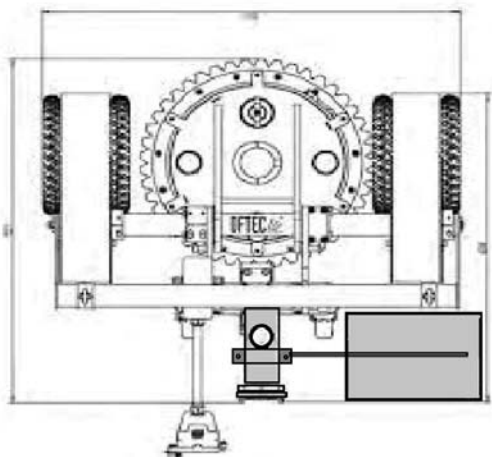
We are looking at the Steel Hose Fitting. for the Crawlers vacuum/pressure hose.

(See the left picture)

This is a sturdy hose fitting, properly fixed to the Crawler. The clamp, attached to the hose fitting, is mounted with swing bolts, for quick and efficient attachment and detachment.

The arm connecting the clamp to the paint applicator is sturdy and horizontally and vertically adjustable

Details on the adjustable arm will follow.



## RPAS Controller

### Welded Steel Cart: Big Dog

Made off 12 Gauge steel, with 2,400 Lbs load capacity.

On the choice of steel: The bending strength of steel increases by approximately the square of its thickness. 12-gauge (.106) steel is 2.86 times stronger than 14-gauge (.075), even though it is only .031 thicker.

Complete with handlebar and 4 off 8" rubber casters; 2 swivel and 2 rigid.

This Welded cart will be rebuild into the controller, holding the Power supplies, Paint compressor, Paint hoses, Paint mixers, Paint supplies, spare parts and electronics.

» Note: On one side of this cart are Tool drawers mounted. (Not shown)



## General description

**Compressor/Pump:** 2.0 HP Graco Ultra Max. Installed on the Cart, With electronic controller. Chrome over steel for durability.

Max paint flow: 0.95 GPM ( 3.5 Liters per minute) This flow is needed to feed the two spray applicators on the robot. Max tip size is 0.031

Quiet Pump with Brushless DC motor (No brushes to change) easy to service.

Smart Control 3.00 Pressure control delivers consistent spray fan.

Connected to 150 feet of hose.

Weighs 103 lbs / 47 Kg





### Paint controller:

LED display; easy to read LED displays shows pressure read out, job/lifetime/gallon counter and self diagnostics.

Easy on and off control through a remote operated controller. The Robot controller can stop and start the paint flow. The applicator movement can only be controlled from the

### Pneumatically controlled Solenoid-Driven Spray Dispenser.

We use Air and Oil over electronics at and on the robot, due to the applicable high magnetic fields, which would make the operations of any of our devises less secure.



This dispenser can be activated and controlled by the robot operator, or by a separate operator.

### Cleaning:

FastFlush Cleaning system clans the unit fast, using limited amount of water.

### Camera System

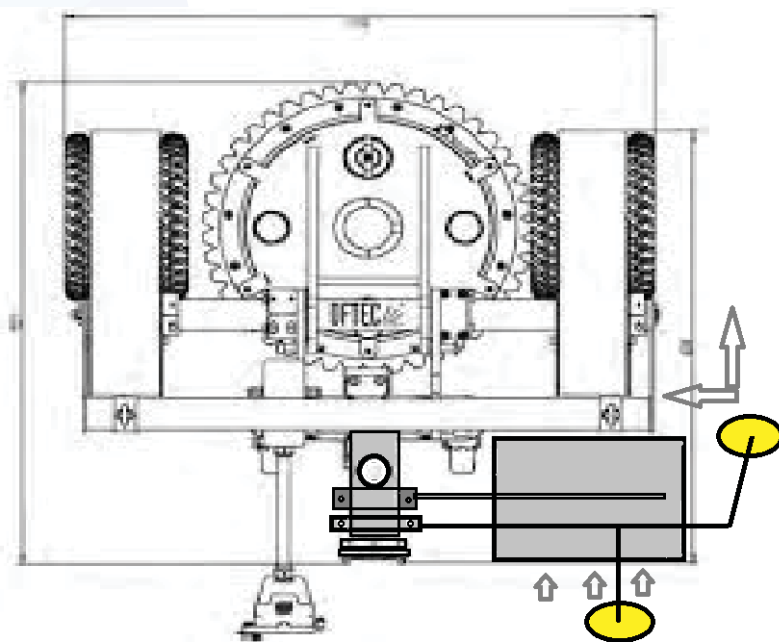
We propose two cameras in this system.

One located high(er) up to obtain a clear view between the pain applicator and the Robots wheel. This would observe the path before painting (Right side camera)

It would also allow to see any obstructions or debris at this location and get a visual on the Robot itself.

The second camera (In lower position) will observe the actual paint applied.

The cameras will be fixed focus and in a steel EX rated housing.



The Camera is EX rated and gas tight.  
 HD for high resolution and light sensitive.  
 Working temperatures are – 20 to Plus 70 Degrees C.

We choose this camera as this is a small and light camera (1.5 Kg) with high resolution.

Both cameras will have an additional Polycarbonate screen in front of the camera lens. Easily removable and replaceable, in case of paint build up.

We will angle the cameras away from the Paint “foam” and add a solution to the screen to delay any possible paint build up

The location of the cameras is above and away from the paint applicator.

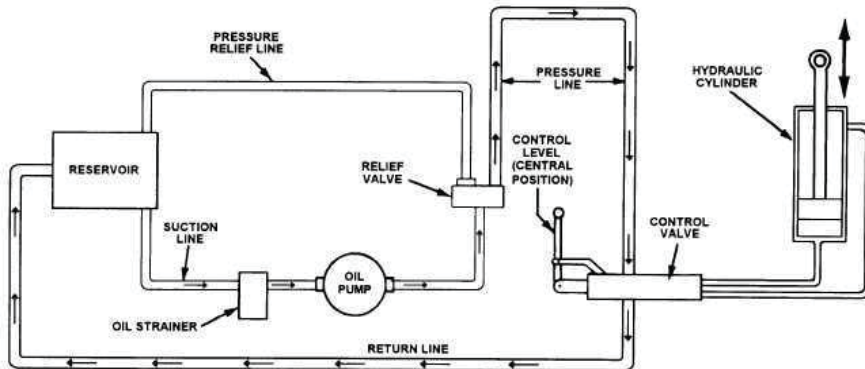
» Note: The paint applicator will have a screen placed over it to prevent any “foam” to reach the cameras.

### Camera Paint distractor system

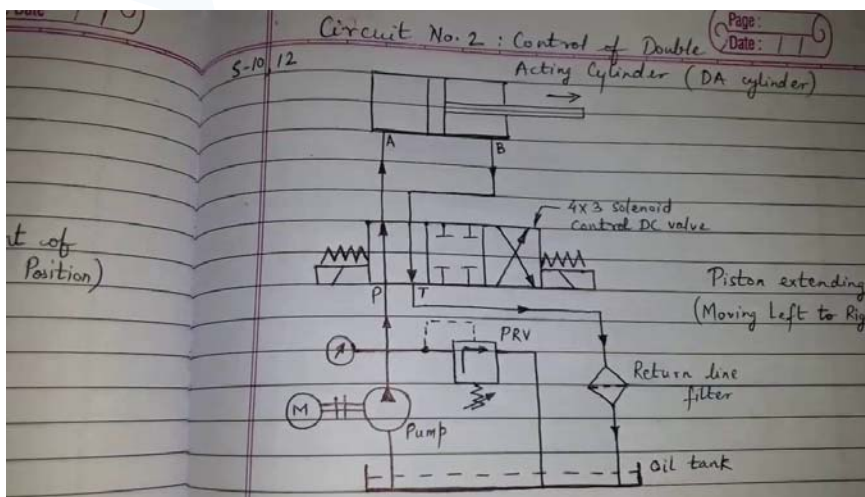
The face of the cameras will have a plenum with air flowing over the face of the screen. This is one more

The RPAS controller will be fitted with an Ambient airpump. This supplies air under 5 PSI pressure, through a 0.25 inch hose in the RPAS umbilical, to the two cameras.

The airflow is guided, through air nozzles, over the face of the camera screens, with that, diverting the paint “foam” away from the camera.



My thoughts on the pressure control system(s)





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