



RESPA Case Study

Title: RESPA-CF/CFX on Bulldozer in Coal Mine, load out area

Summary: Prior to installation, operators had to wear respirators and shower at the end of every shift. They often worked with doors open due to diesel fumes in the cab. Filters only lasted 250 hours and the evaporator cores were cleaned every 500 hours, however the AC stopped cooling after 100 hours. Since installing the RESPA system, the cab stays clean, cool and comfortable and no filter change is required for the full 1000 hour maintenance interval; the evaporator cores stay clean too and there have been no HVAC repairs needed. Operators no longer need to wear respirators and they are still clean at the end of shift. We hope to install this system on all the machines in the mine.

| Company Information | |
|---------------------|-------------------------|
| Company Type: | coal mining |
| Location: | la Loma Cesar. Colombia |

| Test Criteria | | | | | | | | | | | | | | | | | |
|---|--|---------------------------|--------------|----------------------------|--------------|--|-------------|--|--------------|--|---------------------------|--|----------------------------|---|-----------------------------------|--|--------------|
| Brief Statement of Problem: | Excessive dust in the cab, the operators showered after every shift, 500 hours cleaning interval of the evaporator core, 250 hours fresh air and recirculation filter change. When the bulldozer was refueled, the vapors of the diesel stayed inside the cab causing dizziness, operators worked with doors open because of the fumes. After 100 hours, air conditioners stopped sending cool air to the cab. | | | | | | | | | | | | | | | | |
| What would constitute a successful test completion? | 1000 hours of filter change interval without dust getting inside the cab. | | | | | | | | | | | | | | | | |
| Environment(s): | <table border="1"> <tr> <td>x</td> <td>Humid</td> <td>x</td> <td>Dry Dust</td> </tr> <tr> <td></td> <td>Muddy</td> <td></td> <td>Mixed Debris</td> </tr> <tr> <td></td> <td>Heavy Debris</td> <td></td> <td>Snow</td> </tr> <tr> <td>x</td> <td>Extreme Heat</td> <td></td> <td>Extreme Cold</td> </tr> </table> | x | Humid | x | Dry Dust | | Muddy | | Mixed Debris | | Heavy Debris | | Snow | x | Extreme Heat | | Extreme Cold |
| | x | Humid | x | Dry Dust | | | | | | | | | | | | | |
| | | Muddy | | Mixed Debris | | | | | | | | | | | | | |
| | | Heavy Debris | | Snow | | | | | | | | | | | | | |
| x | Extreme Heat | | Extreme Cold | | | | | | | | | | | | | | |
| Other Environment: | | | | | | | | | | | | | | | | | |
| Application: | <table border="1"> <tr> <td>x</td> <td>Mining</td> <td></td> <td>Construction</td> </tr> <tr> <td></td> <td>Agriculture</td> <td></td> <td>Forestry</td> </tr> <tr> <td></td> <td>Waste Industry - Landfill</td> <td></td> <td>Waste Industry - Recycling</td> </tr> <tr> <td></td> <td>Waste Industry - Transfer Station</td> <td></td> <td></td> </tr> </table> | x | Mining | | Construction | | Agriculture | | Forestry | | Waste Industry - Landfill | | Waste Industry - Recycling | | Waste Industry - Transfer Station | | |
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| | | Waste Industry - Landfill | | Waste Industry - Recycling | | | | | | | | | | | | | |
| | Waste Industry - Transfer Station | | | | | | | | | | | | | | | | |
| Other Application: | | | | | | | | | | | | | | | | | |
| Notes: | | | | | | | | | | | | | | | | | |

Machine Stats: Before RESPA Installation

| | |
|---|--|
| Manufacturer: | Caterpillar |
| Model: | D11R |
| Precleaning/Filtration Equipment Currently Installed: | original AC system |
| Fresh-air Filter Replacement Interval: | 250 |
| Recirculation Filter Replacement Interval: | 250 |
| HVAC Breakdown/Repair Frequency: | 500 |
| Cost of HVAC Repairs and Machine Downtime: | |
| Maintenance Includes Blowing Out Filter: | no |
| Operator's Comments on Cab Air Quality: | They had to take showers at the end of every shift, wear respirators |
| Notes: | |

RESPA Installation

| | | |
|------------------------------------|--|-------------------------------|
| Total Hours Spent on Installation: | 5 | |
| Machine Hours: | 34303 | |
| A/C Serviced: | yes | |
| Initial Cabin Pressure: | | |
| Cabin Sealing Required: | No | |
| Cabin Pressure After Sealing: | 0.28 inch of water | |
| Installation Location: | <input type="checkbox"/> Roof | <input type="checkbox"/> Hood |
| | <input checked="" type="checkbox"/> Side of Cab | |
| Notes: | REV3K4 Adaptation Kit, REV0003 Fresh Air System (includes Pressure Monitor) and REV0004 Recirculation System | |

Performance Results

Test Period 1

| | | | |
|----------------------------------|--------------------------|-----|--|
| Machine Hours: | 34511 | | |
| Cabin Pressure: | 0.21 | | |
| A/C Service Required: | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> No |
| <i>If Yes, describe service:</i> | | | |
| Condition of RESPA unit(s): | functioning correctly | | |
| Operator's Comments: | | | |

Test Period 2

| | | | |
|----------------------------------|--------------------------|-----|--|
| Machine Hours: | 34613 | | |
| Cabin Pressure: | 0.27 | | |
| A/C Service Required: | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> No |
| <i>If Yes, describe service:</i> | | | |
| Condition of RESPA unit(s): | functioning correctly | | |
| Operator's Comments: | | | |

Test Period 3

| | | | |
|----------------------------------|--------------------------|-----|--|
| Machine Hours: | 35005 | | |
| Cabin Pressure: | 0.19 | | |
| A/C Service Required: | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> No |
| <i>If Yes, describe service:</i> | | | |
| Condition of RESPA unit(s): | functioning correctly | | |
| Operator's Comments: | | | |

Test Period 4

| | | | |
|----------------------------------|-------------------------------------|-----|-----------------------------|
| Machine Hours: | 35310 | | |
| Cabin Pressure: | 0.17 | | |
| A/C Service Required: | <input checked="" type="checkbox"/> | Yes | <input type="checkbox"/> No |
| <i>If Yes, describe service:</i> | | | |
| Condition of RESPA unit(s): | fresh air filter change | | |
| Operator's Comments: | | | |

Machine Stats: After RESPA Installation

| | |
|--|--|
| Fresh-Air Filter Replacement Interval: | 1000 |
| Recirculation Filter Replacement Interval: | 2000 |
| Machine Maintenance Interval: | 250 |
| HVAC Breakdown/Repair Frequency: | None since RESPA Installation 5000 hours ago. |
| Cost of HVAC Repairs and Machine Downtime: | |
| Operator Comments on Air Quality: | It is the best, is cooler during the day, cab stays cleaner. No need for a shower or respirator is needed. |

Testimonials

Job Title:

Maintenance Manager

Comments on Product Performance:

"Before the Respa, we had a lot of complaints from the operators because the air conditioner stopped working after 250 hours, the machine was reported down. We use to change the two filters and then clean the air conditioner system. Every major overhaul we use to strip down the cab, change all the seals, reupholster the hole cab trying to keep all the dirt out and the cab clean as possible. With the Respa the Cabs are cleaner, the pressure monitor tell us that our cab is performing correctly and the best part is that we change filters every 1000 hours and we are scheduling our first air conditioner maintenance with the Respa mplaints from the operators because the air conditioner stopped working after 250 hours, the machine was reported down. We use to change the two filters and then clean the air conditioner system. Every major overhaul we use to strip down the cab, change all the seals, reupholster the hole cab trying to keep all the dirt out and the cab clean as possible. With the Respa the Cabs are cleaner, the pressure monitor tell us that our cab is performing correctly and the best part is that we change filters every 1000 hours and we are scheduling our first air conditioner maintenance with the Respa after 5000 hours"

Job Title:

Machine Operator

Comments on Product Performance:

"The most important thing is that we don't have to take a shower after every shift, we no longer have to use the respirator in the cab because we don't see dust coming out of the vents anymore. Before, when they fueled the bulldozer, we used to work for several hours with the doors open because the filter was on top of the diesel tank and we got vapors and fumes inside the cab, making unbearable working in that environment. The systems works really well and we hope to see it really soon in all the machines in the mine".

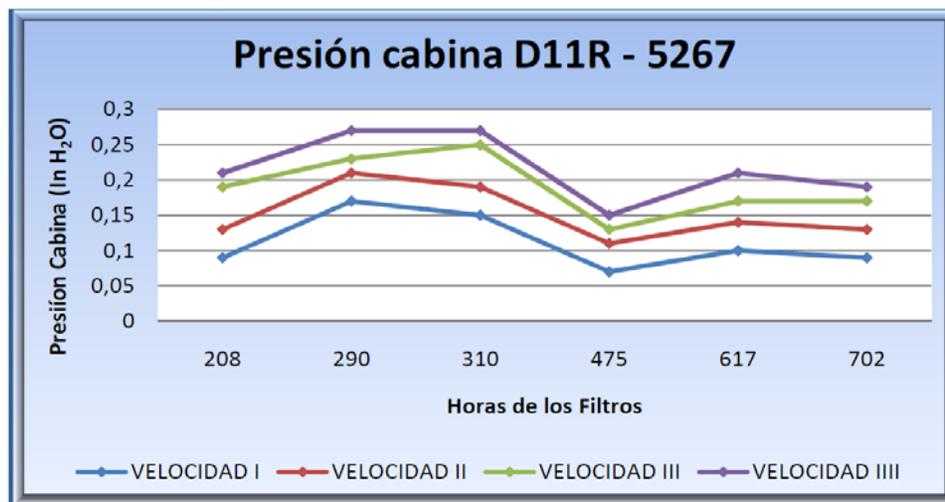


D11R Equipped with RESPA-CF/CFX Cab Air Quality System



RESPA-CF/CFX Installation

| FECHA | HORAS EQUIPO | HORAS FILTROS | VELOCIDAD I | VELOCIDAD II | VELOCIDAD III | VELOCIDAD IIII |
|------------|--------------|---------------|-------------|--------------|---------------|----------------|
| 13/04/2012 | 34303 | 0 | | | | |
| 25/04/2012 | 34511 | 208 | 0,09 | 0,13 | 0,19 | 0,21 |
| 01/05/2012 | 34593 | 290 | 0,17 | 0,21 | 0,23 | 0,27 |
| 09/05/2012 | 34613 | 310 | 0,15 | 0,19 | 0,25 | 0,27 |
| 17/05/2012 | 34778 | 475 | 0,07 | 0,11 | 0,13 | 0,15 |
| 24/05/2012 | 34920 | 617 | 0,1 | 0,14 | 0,17 | 0,21 |
| 28/05/2012 | 35005 | 702 | 0,09 | 0,13 | 0,17 | 0,19 |



Cabin pressure with just the RESPA-CF/CFS running blue line, Fan speeds 1-3 colors Red, Green and Purple.

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