



PART UPGRADE: HEAT EXCHANGER (HX) PRE-FILTER

ALL Power Labs Technical Bulletin: Part # 795-00016

Release Date: May 2016

SUBJECT: Improved Filtration Using Pre-Filter, Intake-Air Heat Exchanger

Models: PP20

Symptoms: Excessive tar contamination of engine and governor and decreased filter media life.

Causes: Tars and other condensates present in Syngas (SG) condensing in filters and engine.

Action: Heat exchanger (HX) is used to cool Syngas (SG) before it enters the packed-bed filter by using the SG's heat to preheat engine intake air. This cooling of the SG helps to condense out many of the tars and other vapors before they enter the filter. The heating of the intake air also prevents further condensation, protecting the engine by allowing them to be burned as vapors.

Installation:

The HX is composed of a 1 m (38") long 150 mm (6") diameter SS shell containing a bundle of 3/4" tubes. Upgrade kit also includes all necessary attachment parts:

Please review Parts List and part inventory image on the following page to assure that you have received all the parts necessary to complete this installation. You may have slightly different parts depending on whether you are doing an initial assembly or an upgrade.



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PARTS LIST *indicates items that differ between new installation and upgrade installation

QTY	PART #	DESCRIPTION
Heat Exchanger Assembly		
1	430-00355 A	Inlet and Outlet Reducing Elbow
1	430-00356 A	Heat Exchanger Body
1	450-00073 A	Wingnut, HX Bracket Attachment 1/4-20
1	472-00153 A	Bolt, HX Bracket Attachment, 1/4-20 X 3"
2	461-00302 A	Clamp for 6" Sani Fitting
2	461-00301 A	PTFE Gasket for 6" Sani Fitting
1	461-00057 B	Clamp for 2" Sani Fitting
1	461-00046 B	PTFE Gasket for 2" Sani Fitting
Gas Lines		
1	430-00364 A	Heated Air Out to Air Throttle Gas Line
1	430-00222 A	Upgrade Extension Gas Line * <i>upgrade only</i>
1	430-00353 A	Air Inlet Filter Elbow
1	430-00354 A	Drying Bucket to HX Gas Line * <i>new install only</i>
4	461-00046 B	PTFE Gasket for 2" Sani Fitting * <i>new install will include only 3</i>
4	461-00057 B	Clamp For 2" Sani Fitting * <i>new install will include only 3</i>
1	461-00298 A	Hose Clamp for Rubber Reducer to Air Line
1	461-00299 A	Hose Clamp for Rubber Reducer to Air Throttle
Filter Canister/Bracket * <i>will already be attached with new install</i>		
1	860-00337 A	Support Bracket Filter Side Bracket Attachment Hardware
2	450-00037 B	Nut, Filter Bracket Attachment 3/8-16
2	472-00154 A	Bolt, Filter Bracket Attachment, 3/8-16 X 3.5"
2	495-00009 B	Washer, Filter Bracket Attachment 3/8"
1	461-00294 A	Filter Drain Ball Valve
Cleaning Kit		
1	485-00063 A	Cleaning Brush Handle
1	485-00064 A	Cleaning Brush Extension
2	485-00065 A	Cleaning Brush Head

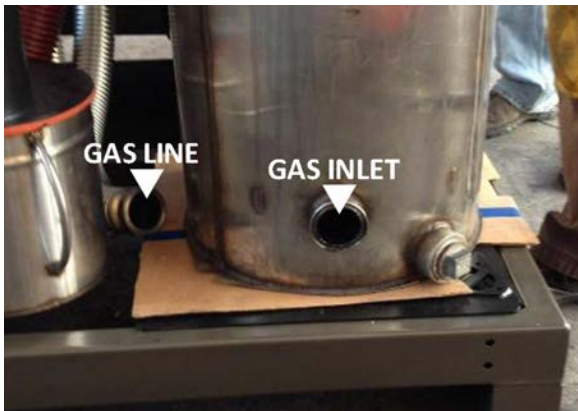


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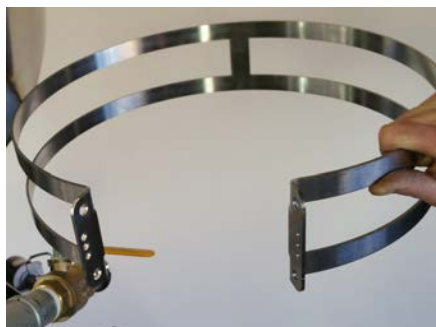
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1. Detach Drying Bucket's Airline from the Filter Gas-inlet Flange and remove the filter lid then turn the filter 90° towards the outside of the skid.
**upgrade only*

2. Attach one Reducing Elbow to the Filter Gas-inlet flange with a 2" sani clamp and gasket, and tighten loosely.



3. Attach the filter side support bracket to filter and install bolts and nuts. Position gap directly inline with Gas-inlet Flange. Install bolts with nuts in top and bottom holes, finger tighten only and reinstall the filter lid with filter arm and tension rod in place and finger tight **upgrade only*



4. Place Heat Exchanger, with the handle above the bracket, on the reducing elbow and attach with 6" sani clamp. Adjust bracket to align any of the bolt holes on the HX mount with any of those in the tabs on the support bracket. **upgrade only* Valves on the filter lid may need to be twisted 10-15 degrees to clear the HX.

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5. Adjust alignment so that bolt installs easily through HX mount and support bracket. Tighten the bracket bolts until bracket tabs are near parallel, then lightly tighten center bolt.

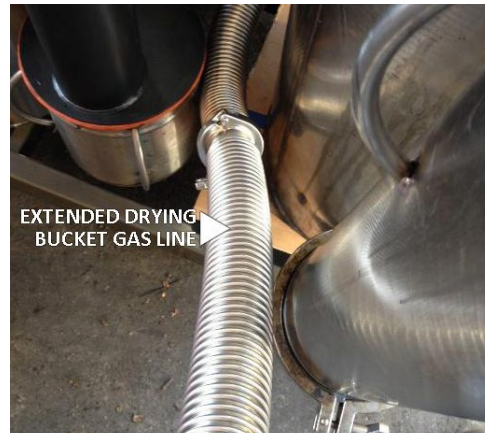
**upgrade only*



6. Install second Reducing Elbow to the top of the Heat Exchanger and attach with 6" sani clamp. Elbow's flange should face the hopper.



7. Attach Drying Bucket Corrugated Air Line extension to upper reducing elbow with 2" sani clamp.



8. Attach Drying Bucket Corrugated Air Line extension section with 2" sani clamp.

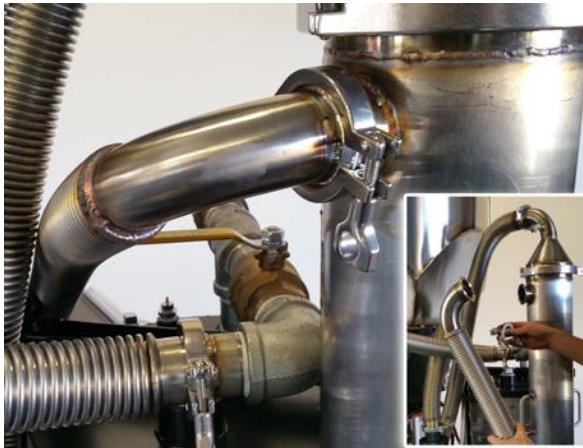
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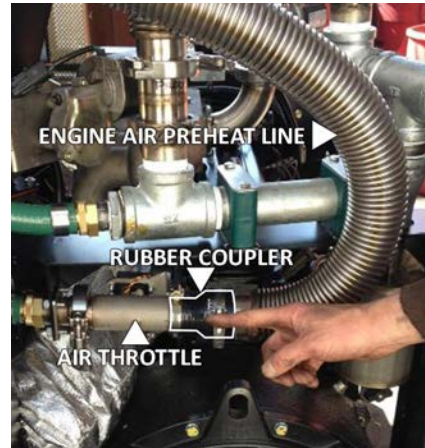
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9. Attach elbow end of the Engine Air Preheat Line to the top side port on the heat exchanger with 2" sani clamp.



10. Attach Engine Air Preheat Line to Air Throttle with Coupler. Bend corrugations to ensure coupler top is not pinched from Air Line tension. Hand-tighten hose clamps until difficult to tighten further.



11. Install Air Filter with Inlet Elbow to bottom side inlet flange of Heat Exchanger with foam filter pointing downward.



12. Apply teflon tape to threads on pipe on opposite end from Ball Valve. Screw Ball Valve drain nipple into lower bung on filter.

**upgrade only*

Check and securely tighten all bolts, sani clamps and hose clamps and perform a leak down test.

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Maintenance

Interval: The HX's job is to remove tars and soot from the syngas, and so will build up inside and will need to be cleaned out regularly. The initial schedule for cleaning should be every 30-40 hours of flare and engine run time combined. However, time between cleanings is impacted by a number of factors. For example (e.g.):

- Different feed stocks species and chemical compositions.
- Varying moisture content of the same feed stock.
- Ambient conditions:
 - Temperature - e.g. summer vs winter.
 - Humidity - e.g. dry vs raining.

Therefore this cleaning cycle is only an **initial recommendation**. You will need to adjust accordingly based on your observations of the rate of buildup in the tubes in consideration of the above-listed variables. Some users may find that in some circumstances cleaning may not be necessary for 100 or more hours, but others may require cleaning after less than 30 hours. Remember that increasing the cleaning frequency will always improve ease of cleaning.

Cleaning tools:

Required and supplied with kit:

- Tube cleaning brush
- Brush extension rod
- Extension rod handle



1. Screw the brush on to the extension rod:
2. insert the threaded end of the rod through the handle such that the threads go through the round flat end.
3. The rod threads will then stick out the top of the handle that has a square flat surface that will match with the nut correctly.
4. Tighten both firmly.



Other tools that may be needed:

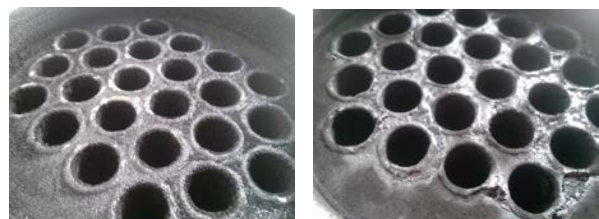
- Bucket or Catch Bin/Pan
- Rags
- Hand-held wire brush
- Solvent e.g.: Denatured Alcohol, Acetone, Gasoline, Diesel or other.
- Dull bladed scraper or flat head screwdriver

If, after opening, the face of the plate has a layer of tar/particulates that is less than the thickness of a fingernail (~2 mm) cleaning is not strictly required, and you may wish to increase the interval for future cleanings.

BEFORE



AFTER



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Maintenance Procedure:

The HX is composed of a 1 m (38") long 150 mm (6") diameter SS shell (for intake air) containing a bundle of 3/4" tubes (for syngas), whose interior walls and the upper and lower plates joining them need to be cleaned.



1. Leaving HX body attached to the filter bracket, remove both upper and lower reducing elbows by removing their sani-clamps, being sure to retain the white gaskets.

2. Place a catch basin beneath the bottom of the HX shell to catch the material that will be removed.



3. Clean the inlet and outlet faces before cleaning the tubes: Scrape or wire brush most of the loose accumulated particulates off of the faces before cleaning the tubes.

4. Use wire brush on cleaning rod to clean the inside of the tubes. Always rotate the brush clockwise. If you rotate CCW there is a chance the brush will unscrew from the extension rod.

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5. Make sure cleaning Brush is pushed all the way through each tube rotating clockwise 10 full revolutions.



6. Take care not to bend or damage the brush by pushing it too out of the far end of the tube and onto another surface.

Take the container you used to catch the contaminants that have been removed from the HX and dump them into the top of the hopper.

Reinstall all gas routing lines and fixtures, and double check that all clamps are tight including the filter lid hold down nut. You're done.

If the above mentioned cleaning procedure is difficult or unsuccessful, shorten the cleaning interval and use the following method as necessary:

- Remove the Cleaning Brush from the end of the Cleaning Brush Extension Rod.
- Stuff a small piece of rag into the top of each tube and push it through with the Extension Rod. Alternately, the the Filter Tension Rod can be used in place of the Cleaning Brush Extension Rod. This provides a larger diameter end and greater force can be exerted on the Tension Rod than can be exerted on the Cleaning Rod.
- If these attempts are unsuccessful, it may be necessary to cap the elbow inlet and outlet and fill with a solvent to soak and rinse out tars. Solvent may be reused after solids are allowed to settle.

Remember, the faces and tubes do not need to shine like new. A layer of tar/particulates as thick as a fingernail after cleaning is acceptable. To verify, place a light reflective card or surface beneath the HX and look down each tube to see to assure they have been effectively cleaned.

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