ENGINEERING STANDARD

Ingersoll Rand
Industrial Technologies

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Title

R-SERIES CONTACT COOLED ROTARY PRODUCT FIRST ARTICLE TEST AND EVALUATION (FATE) SPECIFICATION

1.0 Purpose & Scope

This document defines the process by which the R-Series Manufacturing Build (MB) packages are tested to ensure that the package meets the expectations of the customer. It is not intended to be a complete work instruction for production test. The Operations Group has the responsibility for the Production Test Procedures. This standard is to be used in addition to the Rotary Production Test Standard CCN 23555584, and dryer Pre-Test Standard CCN 23750359, and not in place of these standards.

2.0 Supporting Machine Data

Technical data such as cooling airflow requirements, package performance, compressor dimensions, etc. can be found in the engineering data pages. This data will be under EC control.

Model (50 Hz)	Engineering Data Page CCN
R90IHA (IE3)	23561186
R90I (IE3)	23555873
R110I (IE3)	23555857
R90IHA (IE2)	23667561
R90I (IE2)	23667579
R90IEHA(IE3)	23663859
R90IE(IE3)	23663776
R110IE(IE3)	23663768
R90NE(IE3)	23663750
R110NE(IE3)	23663743
R132I(IE3)	23663735
R132N(IE3)	23663727
R132IHA(IE3)	23663834
R132IEHA(IE3)	23663842
R132IE(IE3)	23663719
R132NE(IE3)	23663701
R160I(IE3)	23663651
R160N(IE3)	23663644
R160IE(IE3)	23663636

Model (50 Hz)	Engineering Data Page CCN
R90IHA (IE1)	23668981
R90I (IE1)	23667553
R110I (IE1)	23667546
R90N	23555832
R110N	23555824
R90IE (IE1)	23703929
R90IEHA (IE1)	23703937
R110IE (IE1)	23703945
R132I (IE1)	23703952
R132IHA (IE1)	23703960
R132IE (IE1)	23703986
R132IEHA (IE1)	23703978
R160I (IE1)	23704000
R160IE (IE1)	23704026
R55IHA (IE3)	23769532
R55I (IE3)	23769540
R75I (IE3)	23769557
R55IHA (IE1)	23769565
R55I (IE1)	23769573

Model (60 Hz)	Engineering Data Page CCN
R90IHA	23561228
R90I	23555865
R110I	23555840
R90N	23555816
R110N	23555808
R90IEHA	23663867
R90IE	23663826
R110IE	23663800
R90NE	23663792
R110NE	23663784
R160I	23663693
R160N	23663685
R160IE	23663677
R160NE	23663669
R55IHA (IE3)	23769631
R55I (IE3)	23769649
R75I (IE3)	23769656
R55IHA (IE1)	23769664
R55I (IE1)	23769672

Model (50 Hz)	Engineering Data Page CCN
R160NE(IE3)	23663628
R55N	23769490
R75N	23769508
R55NTAS	23769516
R75NTAS	23769524
R37IE (IE3)	24192247
R37IEHA (IE3)	24192254
R45I (IE3)	24192262
R37IE (IE2)	24192239
R37IEHA (IE2)	24192270
R45I (IE2)	24192288
R37IE (IE1)	24192296
R37IEHA (IE1)	24192312
R45I (IE1)	24192338
R37IETAS (IE3)	24192346

Model (50 Hz)	Engineering Data Page CCN
R75I (IE1)	23769581
R55ITAS (IE3)	23769599
R75ITAS (IE3)	23769607
R55ITAS (IE1)	23769615
R75ITAS (IE1)	23769623
R45ITAS(IE3)	24192353
R37IETAS (IE2)	24192361
R45ITAS(IE2)	24192379
R37IETAS (IE1)	24192387
R45ITAS(IE1)	24192395
R37NE	24192403
R45N	24192411
R37NETAS	24192429
R45NTAS	24192437

Model (60 Hz)	Engineering Data Page CCN
R75I (IE1)	23769680
R55ITAS (IE3)	23769698
R75ITAS (IE3)	23769706
R55ITAS (IE1)	23769714
R75ITAS (IE1)	23769722
R55N	23769730
R75N	23769748
R55NTAS	23769755
R75NTAS	23769763
R37IE (IE3)	24192452
R37IEHA (IE3)	24192460
R45I (IE3)	24192478
R37IE (IE2)	24192486
R37IEHA (IE2)	24192494
R45I (IE2)	24192502
R37IETAS (IE3)	24192510
R45ITAS(IE3)	24192528
R37IETAS (IE2)	24192536
R45ITAS(IE2)	24192544
R37NE	24192551
R45N	24192569
R37NETAS	24192577

3.0 Equipment

All test equipment should be calibrated and in good condition. The test area should be clean so that the test unit is not contaminated with any residual coolant/debris.

4.0 Performance Test

Performance test to be conducted on each unit per the appropriate rotary production test standard referenced above. For Nirvana models:

- 60Hz performance should be measured at 100 psig, 115 psig, and 135 psig maximum and minimum speeds (6 total measurements)
- 50Hz performance should be measured at 7.0 barg, 8.0 barg, and 9.5 barg maximum and minimum speeds (6 total measurements)

For fixed speed models, the test shall be carried out at the machine rated pressure.

- 60Hz rated pressures (CAGI Test)
  - 100, 115, 135, & 190 psig
- 50Hz rated pressures
  - 7.0, 8.0, 9.5, & 13.5 barg

All test results should be forwarded to Engineering for review.

5.0 Package Cooling Verification Test

A basic package cooling verification test shall be conducted on each unit to confirm that the cooling system is working properly. This test includes the measurement and recording of the CTD and LAT values for each unit.

Aftercooler CTD can be verified by calculating the difference between the package air discharge temperature on the controller and the ambient temperature measurement. The calculated value shall be equal to or less than the CTD value provided in the engineering data pages for the appropriate model.

LAT, or Limiting Ambient Temperature, can be determined using the airend discharge temperature reading from the controller (see formula below). For the LAT test, the ambient temperature should be elevated over 100ºF / 37.8℃ to ensure that the thermal control valve (TCV) is fully stroked. This

temperature then needs to be maintained for approximately 15 minutes to ensure system stability prior to measurement.

For the variable speed Nirvana packages, LAT testing should be performed at 100 psig or 7 barg package discharge pressure.

$$LAT = 101.7℃ – T_{A/E} + T_{Ambient}$$

Where $T_{A/E}$ = Airend Discharge Temperature

LAT is required to be equal to or greater than 46℃. Any nonconforming data shall be immediately communicated to Engineering for review.

6.0 HPM Motor Vibration Test –(55/75kW)

Measure vertical and horizontal vibration FFT's at every 100 rpm between the minimum and maximum rpm of the motor (1000 – 3400 rpm)
FFT: Peak Velocity (mm/s), 0-500 Hz, 800 lines
Locate accelerometers 50mm from the NDE @ 12:00 (V) and 9:00 (H)
Measure and record the minimum gap and the maximum gap for each motor tested.
Generate a report including the vertical and horizontal FFT plot of Velocity (mm/s) vs. frequency (Hz) for each speed (every 100 rpm between 1000 and 3400 rpm)

Discharge pressure should be 100 psi for all measurements.

7.0 Oil Level Test

1. Note the level of oil in the sight glass with BOM specified volume estimate.
2. Add oil if necessary so that the oil level during running is ½ to ¾ while loaded.
3. Note the oil level in stabilized loaded condition.
4. For FS units, unload the unit, allow the sump pressure to stabilize and note the level.
5. Shut the unit down, let pressures vent, and note the oil level.
6. If the oil level during shutdown is not above the oil level during running, then allow the unit to sit for 24 hr and record oil level the next day.

Additional test on one MB unit only:

7. Remove 10L of oil from above condition and repeat steps 3, 4, 5, 6.
8. Add back the 10L of oil removed after above test is complete.

All test results must be forwarded to engineering for review.

8.0 Flutter Test – For MPCV and Inlet Valve

1. Run VSD unit at minimum speed and check for any fluttering noise from the MPCV and Inlet Valve, varying the discharge pressure from 65 to 135 psig.

9.0 Endurance Test Procedure

ALL MB units shall be endurance tested for a minimum of 100 total run hours. Unit should be totally clean of any residual coolant before starting the test.

Endurance test **Standard** fixed speed units as specified in Table 1.

	Test Time (hours)
Minimum run hours for unloaded operation	15
Minimum run hours for loaded operation	50
Minimum total run hours	100

Table 1: Test Procedure for *Standard* R-Series Units

Endurance test **Nirvana** units as specified in Table 2. Start/Stop operation to be performed with the unit set to run at 10 - 20 starts per hour.

	Test Time (hours)
Minimum run hours for start/stop operation	40
Minimum run hours for continuous operation	40
Minimum total run hours	100

Table 2: Test Procedure for *Nirvana* R-Series Units

10.0 Values to Record During Test

Record the following values with the machine loaded; after the machine temperatures stabilize at the beginning of the test procedure, At the 50 hour point, and during the last hour of the test duration.

Machine Serial #		
KW Rating:		
Input Voltage (V):		
	Leg 1	
	Leg 2	
	Leg 3	
Input Power (Kw):		
Total Input Amps (Amp):		
Power Factor :		
Main Motor Current (Amp):		
Main Motor CCN:		
Input Power Fan Motor (Kw):		
Fan Motor Current (Amp):		
Fan Motor CCN:		
Fan Power Factor:		
Ambient Temp. (deg C)		
Full Flow (CFM, BAR)		
Dryer Dew Point (deg F) :		
Input Power Dryer (kW)		
Dryer Current (Amp)		
Time of Test (00:00)		
Operator		

11.0 Acceptance Criteria

The acceptance criteria for the test are that the unit functioned as expected and no coolant or air is observed leaking from any part of the package. If any leaks are observed, the leak is to be repaired and the test restarted. All results shall be forwarded to Engineering for final approval.

Revision History

Revision	Date	Changes	Originator
A	30-Nov-2009	Production Release Version	A Burris
B	6-July-2020	Updated Data Sheets and values to record during testing	J Bailey
C	12/22/2010	Added 55/75kW models; Added HPM motor vibration test; Dryer measurements	S. Kumar
D	2/22/2011	Added oil level tests	S. Kumar
E	7/12/2012	Added 37/45kW models. Added flutter test for MPCV and inlet valve	S. Kumar