



भारत सरकार - रेल मंत्रालय  
अनुसंधान अभिकल्प और  
मानक संगठन  
लखनऊ - 226 011  
EPBX +91 (522) 2451200  
FAX +91 (522) 2458500

Government of India - Ministry of  
Railways  
Research Designs & Standards  
Organisation  
LUCKNOW - 226 011  
DID +91 (522) 2450115  
DID +91 (522) 2450110



No. SD. Aux. EMD.FP Motor

Date: As Signed

**चीफ मोटिव पावर इंजीनियर / डीजल**

1. मध्य रेलवे, छत्रपति शिवाजी महाराज टर्मिनस, मुम्बई- 400 001
2. पूर्व रेलवे, फेयरली प्लेस, कोलकाता- 700 001
3. उत्तर रेलवे, बडौदा हाऊस, नईदिल्ली- 110 001
4. पूर्वोत्तर रेलवे, गोरखपुर- 273 001
5. पूर्वोत्तर फ्रन्टियर रेलवे, मालीगाँव, गुवाहाटी- 781 011
6. दक्षिण रेलवे, एनेक्सी, पार्कटाऊन, चेन्नई- 600 003
7. दक्षिण मध्य रेलवे, रेल निलायम, सिकन्दराबाद- 500 071
8. दक्षिण पूर्व रेलवे, गार्डनरीच, कोलकाता- 700 043
9. पश्चिम रेलवे, चर्चगेट, मुम्बई- 400020
10. उत्तर मध्य रेलवे, प्रयागराज - 211 033
11. उत्तर पश्चिम रेलवे, जयपुर- 302 006
12. पूर्व मध्य रेलवे, हाजीपुर- 844 101
13. पूर्व तट रेलवे, रेलवे कॉम्प्लेक्स, भुवनेश्वर- 751 023
14. दक्षिण पश्चिम रेलवे, हुबली- 580 023
15. पश्चिम मध्य रेलवे, जबलपुर- 482 001
16. दक्षिण पूर्व मध्य रेलवे, बिलासपुर- 495 004

**SUB: Modification on Fuel Pump of HHP Loco.****Ref:** Railway Board Letter No. 2022/M(L)/466/23 dated 04.01.2023

RDSO had issued the Mod sheet no. MP.MOD.EM.02.08.15 dt. 27.11.2015 for providing standby inverter in 25 locos preferably on locos for passenger service each by diesel loco sheds GY, SGUJ, BGKT, and KJM for trials purpose. Further, RDSO vide letter no. SD.Aux.EMD.FP Motor dated 11-02-2019 issued advisory to undertake additional modification in which an air gap is to be created by providing shim for improved cooling of inverter in existing FPM inverter fitted with Fuel Pump Motor.

As per above referred MOM on HHP locomotives held at NR on 08.12.22 , RDSO was requested to advise technical instructions to ZRs on the failures of Fuel Pump Motor.

RDSO collected feedback against trials mod sheet and advisory on the FPM inverter failure. Based on data collected, RDSO reviewed the modification and the Mod sheet has been revised for provision of standby inverter and shim (in existing inverter fitted with 0.75 HP FPM) for implementation in HHP Diesel Locomotives.

Revised Mod sheet no. MP.MOD.EM.02.08.15 (Rev-01) is enclosed herewith for kind information and implementation.

Railways are requested to furnish the status of implementation and performance feedback as per format given below on monthly basis for evaluation.

**Status of implementation of Mod Sheet no. MP.MOD.EM.02.08.15 (Rev-01)**

S N	SHE D	LOC O NO	DATE OF MODIFICAT ION OF SHIM AS PER MOD SHEET	DATE OF FITMEN T OF STAND BY INVERT ER AS PER MOD SHEET	MAKE OF STAND BY INVERT ER	DATE OF FAILURE OF MAIN INVERTER IN FPM AFTER SHIM MODIFICAT ION AS PER MOD SHEET	DATE OF FAILUR E OF STAND BY INVERT ER	WHETHE R SWITCH OVER TO STANDBY INVERTE R PREVENT ED LINE FAILURE	REMAR KS WITH FAILUR E DETAIL S, IF ANY

- In case, modification is yet to be carried out, “NIL” may be indicated.
- In case, no failure after modification, “NO FAILURE” may be indicated.

The status in the given format may be sent at email id [adeecmp@rdso.railnet.gov.in](mailto:adeecmp@rdso.railnet.gov.in), [ancha.0191@gov.in](mailto:ancha.0191@gov.in).

**DA: Mod Sheet No. MP.MOD.EM.02.08.15 (Rev-01).**

Digitally Signed by Vikas  
Verma

Date: 24-05-2023 16:03:48

Reason Approved  
(विकास वर्मा)

निदेशक/ई०एम०/चालन शक्ति

Copy to :

1. CWMs, Jamalpur, Parel, Ajmer, Charbagh, New Bongaigaon, Golden rock : For kind information and necessary action.
2. CDE/Dsl, BLW, Varanasi : For kind information.
3. DME/Traction, Railway Board, New Delhi : For kind information.

Document No:	MP.MOD.EM.02.08.15	Revision No: 01	Date Issued: 18.05.2023
Modification Sheet Title: Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives			



भारत सरकार/Government of India,

रेल मंत्रालय/Ministry of Railways

अनुसंधान अभिकल्प एवं मानक संगठन/Research Designs & Standard Organization

मानक नगर, लखनऊ/Manak Nagar, Lucknow – 226011.

**Document No.MP.MOD.EM.02.08.15 (Rev-01) 18-05-2023**

**Document Title**

**Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pump motors of HHP Locomotives**

**Amendment History:**

S. No.	Amendment Date	Revision No	Reasons for Amendment
1.	27.11.2015	00	Provision of standby inverter for fuel pump motor of HHP Locomotives.
2.	18.05.2023	01	Provisions of standby inverter and shim (in existing inverter fitted with FPM) for fuel pump motors of HHP Locomotives.  Technical Specification of Standby Inverter and Tests elaborated.



Document No:	MP.MOD.EM.02.08.15	Revision No: 01	Date Issued: 18.05.2023
Modification Sheet Title: Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives			

**1) Title:**

Mod sheet for Provision of standby inverter and shim (in existing inverter fitted with FPM) for fuel pump motors on HHP locomotives.

**2) Background:**

A. Railways have been reporting high rate of failures of AC Fuel Pump motors of HHP locomotives. Majority of the failures are attributed to the inverter failures.

B. During the CMPE's conference held at NDLS on 11<sup>th</sup> & 12<sup>th</sup> August'2015, GY shed shared 3 months trial report on modification carried out in 14 locos by providing a standby inverter. Accordingly, Mod sheet no. MP.MOD.EM.02.08.15 dt. 27.11.2015 was issued on standby inverter for implementing modification in 25 locos preferably on locos for passenger service each by diesel loco sheds GY, SGUJ, BGKT, and KJM. Further, sheds have also undertaken additional modification in which an air gap has been created by providing shim for improved cooling of inverter. The advisory for provision of shims was also circulated by RDSO vide letter no. SD.Aux.EMD.FP Motor dated 11-02-2019.

RDSO collected feedback against mod sheet and advisory issued on the FPM inverter failure. As per data collected, it is observed that this modification has reduced the online failure of locomotives and the reliability of the locos have improved with standby inverter.

Accordingly, RDSO reviewed the modification and the Mod sheet has been revised for provision of standby inverter and shim (in existing inverter fitted with FPM) for implementation in HHP Diesel Locomotives.

**3) Object:**

Provision of standby inverter and shims (in existing inverter fitted with FPM) for fuel pumps motors (0.75 HP) on HHP locomotives.

**4) Application to class of locomotives:**

BG Diesel electric HHP locomotives equipped with AC Fuel Pump motors (0.75 HP).

**5) Brief modification content:**

a) Provision of additional inverter to be provided at equipment rack (lube oil cooler mounting channel).Ref. Fig-1

Document No:	MP.MOD.EM.02.08.15	Revision No: 01	Date Issued: 18.05.2023
Modification Sheet Title: Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives			

- b) Provision of selector switch (Rotary switch 30A, 6NC-6NO interlocks) fitted to a wooden box shall be located near water tank to select existing inverter and standby inverter. Refer fig-1 & fig-4.
- c) Provision for maintaining gap between motor and inverter by providing 5mm thick aluminum shims (2no's) with heat sink compound to enhance the cooling efficiency of existing inverter fitted with Fuel Pump Motor (*Which is beyond warranty*) as shown in fig.2.



Fig.1 Location of fitment of inverter and selector switch

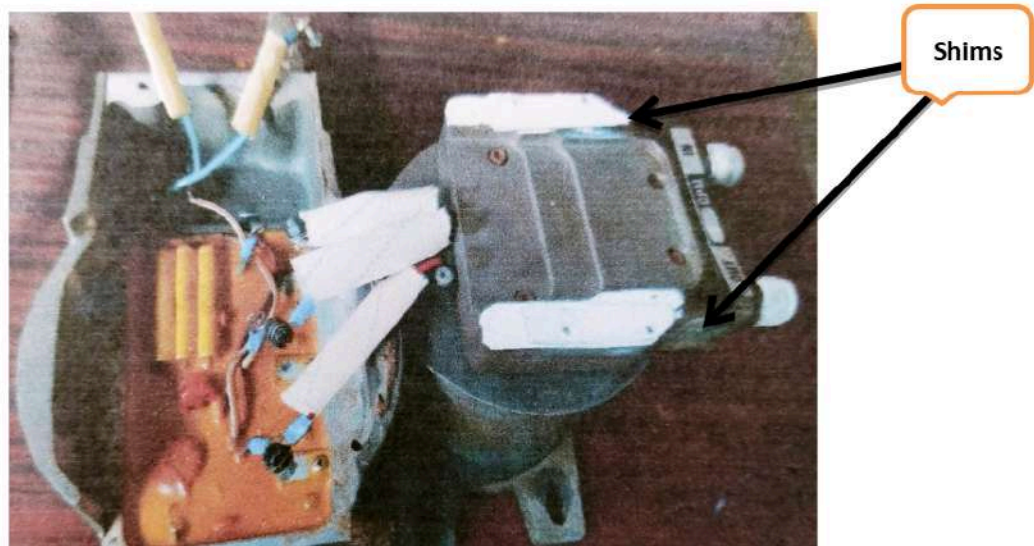


Fig.2. Motor with shims

Document No:	MP.MOD.EM.02.08.15	Revision No: 01	Date Issued: 18.05.2023
Modification Sheet Title: Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives			

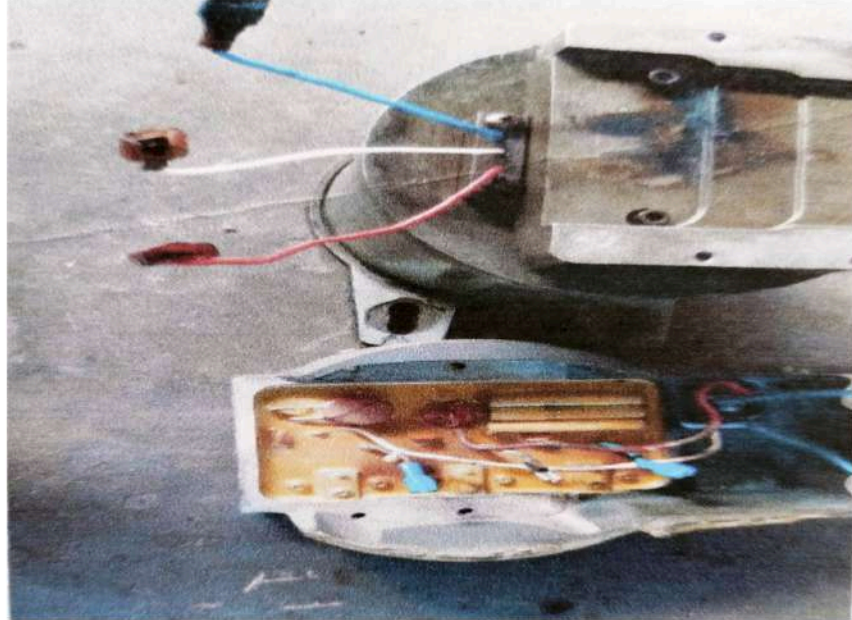
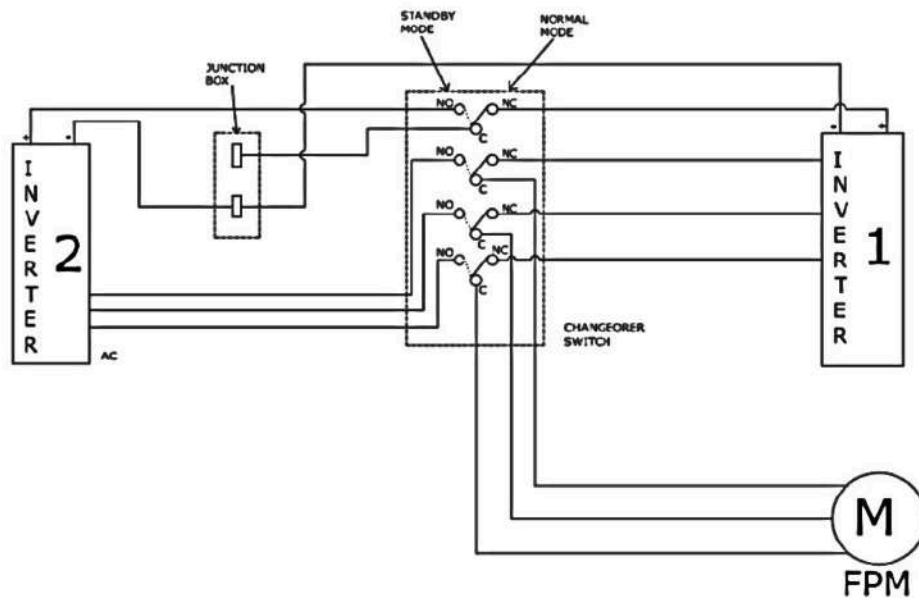


Fig.3. Motor without shims





Document No:	MP.MOD.EM.02.08.15	Revision No: 01	Date Issued: 18.05.2023
Modification Sheet Title: Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives			

Fig.4. Connection diagram for fitment of inverter and Rotary Switch

## 6) Materials required:

**A.** Following materials required for standby inverter for fuel pump motor which is located near lube oil filter drum (On equipment rack):

S. No.	Description	Qty/ loco
1	Terminal lug to EMD pt.no:8210498	14 nos.
2	Flexible pipe 1" dia	1 ½ mtrs.
3	14 AWG wire	16 mtrs.
4	Butt connector 2 way pt.no: 8200891	02 nos.
5	M12 x 1.75 -30mm bolt with nut	02 nos.
6	Wooden box of size 150x150x150mm – 10mm thick	01 no
7	Rotary switch 30A	01 no
8	Ultra-fast fully insulated terminal lug EMD pt.no: 4-521098-2	03 nos.
9	Ultra-fast fully insulated terminal lug EMD pt.no: 4-520448-2	03 nos.
10	M5 x 0.8 x 25mm bolts with nuts	04 nos.
11	Metal plate (140mmx110mmx3mm)	01 no
12	Inverter	01 no

**B.** The material required for standby inverter for fuel pump motor which is located underneath the frame:

S.N.	Description	Qty/loco
1	Terminal lug to EMD pt. no: 8210498	14 nos.
2	Flexible pipe 1" dia.	4½ mtrs
3	14 AWG wire	35 mtrs

**File No.RDSO-MP0LKO(EM)/11/2019-O/o JD/EM/MP/RDSO**

Document No:	MP.MOD.EM.02.08.15	Revision No: 01	Date Issued: 18.05.2023
<b>Modification Sheet Title: Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives</b>			

4	Butt connector 2 way pt.no: 8200891	02 nos.
5	M12 x 1.75 -30mm bolt with nut	02 nos.
6	Wooden box of size 150x150x150mm – 10mm thick	01 no
7	Rotary switch 30A	01 no
8	Ultra-fast fully insulated terminal lug EMD pt.no: 4-521098-2	03 nos.
9	Ultra-fast fully insulated terminal lug EMD pt.no: 4-520448-2	03 nos.
10	M5 x 0.8 x 25mm bolts with nuts	04 nos.
11	Metal plate (140mmx110mmx3mm)	01 no
12	Inverter	01 no

The above mentioned auxiliaries are for guidance purpose and may vary at the time of actual fitment as per convenience at the diesel shed.

**7) Technical Specification of inverter:**

Power Capacity:	Continuous-800W Peak-1500W
Nominal Voltage	74 VDC
Input Current	7.5-8A @74 VDC with 4Kg/cm <sup>2</sup> pressure
Output Frequency	3 Phase, 50-60 Hz
Output wave form	Quasi-Sine wave
THD	<5%
Input Voltage Range	50 V to 90 V DC with 15% ripple. Effect of inverter switching on input DC should not cause ripple current more than 5% at full load. 70% torque should be delivered at 17V DC input voltage. During cranking of loco voltage may dip to 17 V for a short duration. Inverter should not trip during this duration
Short time rating	Minimum 10 sec duration at 1.5 times the rated current
Input over voltage protection	100 V DC input
Output over load protection	1.5 times the rated current
Motor Drive Method	PWM with v/f control
Ambient temperature	55 °C
Cooling Method	Natural or self-cooled
Enclosure standard	IP65
Connection	Power Terminal screw block

**Note:** The Supplier shall furnish Datasheet and Undertaking that the Inverter is complying the vibration and shock tests as per IEC 61373 or its equivalent and the inverter is also complying other environmental test conditions required for Rolling Stock application.



<b>Document No:</b>	MP.MOD.EM.02.08.15	<b>Revision No:</b> 01	<b>Date Issued:</b> 18.05.2023
<b>Modification Sheet Title:</b> Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives			

**8) Acceptance Tests may be carried out by the firm on the sample size as defined by the Zonal Railway as per Annexure-1 as tabulated below:**

<b>Sl. No</b>	<b>Tests</b>	<b>Remarks</b>
1.	Preliminary Checking	Pass/Fail
2.	Temperature Rise Test (Measurement by thermometer)	Pass/Fail
3.	Over Voltage Protection Test	Pass/Fail
4.	Insulation Resistance (IR) Test before Dielectric Test	Pass/Fail
5.	Dielectric Test	Pass/Fail
6.	IR Test after Dielectric Test	Pass/Fail
7.	Reverse Polarity Test	Pass/Fail
8.	Short Circuit Test	Pass/Fail
9.	V/f Control Test	Pass/Fail
10.	Performance Test	Pass/Fail

**9) Sources of supply:**

Based on the supply of fuel pump inverter in Diesel Loco (HHP & ALCo), following firms may be considered as likely source of supply.

- i) Greentech Labs  
#140, Kalmane, 2nd Cross, 1st Phase,  
Reliable Residency  
Harlur, HSR Layout, Bangalore-560102
- ii) Progress Rail innovations Pvt. Ltd.  
D-149 to 153 & 178 to 182,  
Hosiery Complex Noida Phase-II Extn Noida,  
Uttar Pradesh - 201305
- iii) Signotron (India) Pvt. Ltd.  
Plot J1-6, Block-EP,  
Sector-V Salt Lake Electronic Complex  
Kolkata, West Bengal – 700091
- iv) Elixir Engineering  
No 6 SFHS Shopping Area  
Nandini Layout Bangalore,  
Karnataka – 560096
- v) Medha Servo Drives Pvt. Ltd.  
Jodimetla Cross Road,  
Korremula Village, Ghatkesar Mandal  
Hyderabad,Telangana – 500088

**File No.RDSO-MP0LKO(EM)/11/2019-O/o JD/EM/MP/RDSO**

Document No:	MP.MOD.EM.02.08.15	Revision No: 01	Date Issued: 18.05.2023
Modification Sheet Title: Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives			

- vi) M/s Auto Industries India  
Plot no. 209, Sector Udyog Kendra Ext-II,  
Ecotech-III, Gautam Budh Nagar,  
Greater Noida UP.

However, Railways may at their own discretion, procure these items for subject modification from any suitable firm complying the technical specification of the inverter as given at Para-7 above.

**10) Additional information:**

The selector switch should be set at existing Inverter fitted with Fuel Pump Motor in default mode.

**11) Agency and schedule of implementation:**

Diesel Sheds and Diesel Workshop.

**12) Distribution:**

As per enclosed list.

**13) References:**

- A) BLW letter No. 2016/SPC/13/13.1 dated 28.05.2022 regarding minutes of CMPE's, CWM's, BLW, RDSO and Railway board officers held at BLW/BSB on 06.05.2022 to 07.05.2022. (Point no 6.7 of Discussion of Agenda items).
- B) Minutes of meeting of CMPE's, RDSO, BLW, PLW and Workshop's held on 08.12.2022 at Railway Board New Delhi. (Point no 3.2 & 6.2 of Discussion of Agenda items).
- C) This office letters no SD.Aux.EMD.FP Motor dated 11.02.2019 & 13.12.2022.

Document No:	MP.MOD.EM.02.08.15	Revision No: 01	Date Issued: 18.05.2023
Modification Sheet Title: Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives			

**ANNEXURE-1**

**1. Preliminary Checking:**

- a. Inverter shall be checked properly for the loose connections of the leads, heat sink and other visible defects.
- b. All fasteners shall be checked for tightness.
- c. Physical dimensions of the inverters shall be checked in accordance with the approved drawings.
- d. Equipment no. plate to be verified.
- e. Power ON check is to ensure that the system is working normal when the rated input voltage is connected to the system

**2. Temperature Rise Test (Measurement by thermometer):**

**Heat Run Test:**

The inverter shall be allowed to run at 74 V DC input and at full load till the temperature is stabilized. Following parameters shall be recorded after every 15 minutes during the run.

Ambient temperature before start-----

Time	Ambienttemp.	Temp. Riseof Body

Manufacturer shall provide the device junction temperature calculations due to temperature rise and the value of device junction temperature obtained by calculation shall be 25 deg C less than the designed value of device junction temperature of device manufacturer.

**3. Over Voltage Protection Test:**

The inverter shall trip at 100 V DC input voltage. The unit shall work satisfactorily after completion of this test.

**4. Insulation Resistance (IR) Test before Dielectric Test:**

Insulation resistance value of the inverter shall be measured at 500 V DC and recorded. It should not be less than 10 mega ohms.

**5. Dielectric Test:**

This test shall be carried out on inverter separately. The test voltage shall be alternating sine wave, frequency being 50 Hz to 60 Hz. For inverter a test voltage of RMS value of 1.2 KV shall be applied for a period of one minute between shorted connections and frame.



Document No:	MP.MOD.EM.02.08.15	Revision No: 01	Date Issued: 18.05.2023
<b>Modification Sheet Title: Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives</b>			

The inverter shall be connected at a voltage of less than one third of test voltage and shall be increased gradually to the full test voltage. The test shall be considered satisfactory if neither a disruptive discharge nor a flash over occurs.

**6. IR Test after Dielectric Test:**

Insulation resistance of the inverter shall be measured after the dielectric test and there shall be no appreciable difference between the two values, one before the test and one after the test.

**7. Reverse Polarity Test:**

The inverter shall be connected to 74 volts DC input supply in reverse polarity for a period of 2 minutes. At the end of the test, the inverter shall work satisfactorily when the connections at the input are restored to correct polarity.

**8. Short Circuit Test:**

The fault current shall be detected and cleared by the protective circuit of inverter. Inverter shall work satisfactorily after this test.

**9. V/f Control Test:**

The inverter shall be mechanically loaded with Fuel Pump Motor according to its rating. The voltage shall be varied from 20V to 65V (17 V to 65 V for AC Fuel Pump Motor) in steps of 10 Volts. The following parameters shall be recorded:-

- a. Output AC volts of inverter (Vac).
- b. RPM
- c. Output frequency of inverter in Hz.
- d. Torque in Kgm (Desirable)
- e. Current in Amp.

The ratio Vac/f shall be calculated. The values so obtained shall be within +20% of nominal value. The torque measured shall not be less than 70 % of full load torque.

**10. Performance Test:**

The inverter shall be loaded with Fuel Pump Motor according to its rating. The performance characteristics shall be observed at 65 V, 72V and 90 V DC input to inverter. The following parameters shall be recorded:-

- b) Input DC voltage to inverter (Vdc).
- c) Input DC current to inverter (Idc).
- d) Output AC volts of inverter (Vac).
- e) Output AC current of inverter (Iac).

**File No.RDSO-MP0LKO(EM)/11/2019-O/o JD/EM/MP/RDSO**

Document No:	MP.MOD.EM.02.08.15	Revision No: 01	Date Issued: 18.05.2023
Modification Sheet Title: Provision of standby inverter and shim (in existing inverter fitted with FPM) on fuel pumps motors of HHP locomotives			

- f) Input frequency in Hz.
- g) Power factor
- h) Inverter efficiency = 
$$\frac{\sqrt{3}V_{ac} \times I_{ac} \times \text{Power factor}}{V_{dc} \times I_{dc}}$$

The output AC volts of inverter, input frequency, power factor recorded at 65 V, 72V and 90 V DC input to inverter shall be within the design limits. Inverter efficiency calculated at 65 V, 72V and 90 V DC input to inverter shall not be less than the design values. Wave form of Inverter output should also be captured.