



No. EL/3.2.19/3-Phase

Date 18.07.2019

**Principal Chief Electrical Engineer,**

1. Central Railway, Mumbai CST-400 001.
2. Northern Railway, Baroda House, New Delhi-110001.
3. North Central Railway, Subedarganj, Allahabad- 211001
4. North Eastern Railway, Gorakhpur-273 001
5. Eastern Railway, Fairlie Place, Kolkata -700 001.
6. East Central Railway, Hazipur-844101.
7. East Coast Railway, Chandrashekharpur, Bhubaneswar-751016.
8. Southern Railway, Park Town, Chennai-600 003.
9. South Central Railway, Secunderabad-500 371.
10. South Eastern Railway, Garden Reach, Kolkata -700 043.
11. South East Central Railway, Bilaspur-495004
12. Western Railway, Churchgate, Mumbai-400 020.
13. West Central Railway, Jabalpur-482001.
14. Chittaranjan Locomotive Works, Chittaranjan-713331 (WB)
15. Diesel Locomotive Works, Varanasi-221004
16. DMW, Patiyala- 147003

**Sub: Minutes of meeting and workshop on Brake system of 3-phase locos held at ELS/ RPM on 7&8.06.2019.**

A meeting and workshop was held at ELS/RPM/SR to discuss the reliability related and maintenance issues of Brake System of 3-phase locomotives. Representatives of electric loco sheds, representatives of OEMS & suppliers of brake equipments were present. The MOM has been issued and uploaded on RDSO's website under following link:

[https://rdso.indianrailways.gov.in/view\\_section.jsp?lang=0&id=0,2,344,5544,5552](https://rdso.indianrailways.gov.in/view_section.jsp?lang=0&id=0,2,344,5544,5552)

*(Signature)*  
18/7/2019  
(Aseem Kumar)

For Director General electrical

Encl: Nil

Copy To:

- Secretary (Electrical), Railway Board, Rail Bhawan, New Delhi-110001  
(Kind attn.: Shri A. K. Goswami, DEE/RS/RB) for kind information please.
- M/s. Faiveley Transport Rail Technologies India Limited, P.B. No. 69, Harita, HOSUR, Tamil Nadu- 635 109
- M/s. Knorr-Bremse India Pvt. Ltd. 51/4 KM Stone, Village & P.O. Bhagola, Delhi Mathura Road (NH-2), Palwal-121102 (HARYANA)
- Patra & Chanda Mfg. & Engg. (India) Pvt. Ltd., Unit-I, 72, Panchanantala Road, Howrah-711101
- Topgrip Indus Instruments Pvt. Ltd., 37C, Jheel Road, Dhakuria, Kolkata-700 031
- Midlands & Co., Mukherjee Industrial Complex, Mahamayatala Garia, Kolkata-700 084

*(Signature)*  
18/7/2019  
(Aseem Kumar)

For Director General electrical

Encl: Nil

190718 Covering of workshop at ELS\_RPM

**Minutes of meeting and workshop on Brake system of 3-phase locos held at ELS/ RPM on 7&8.06.2019**

A meeting cum workshop was organized by RDSO at Electric Loco Shed, Royapuram, Southern Railway to discuss the issues of reliability of Brake systems of 3-phase locos wherein representatives from Zonal Railways (ZRs), Brake system suppliers and their vendors for pressure gauges participated.

At the outset, CELE/SR welcomed all the participants who have come from the different parts of the country. The various issues discussed are summarized as follows:

**A. Issues pertaining E-70 brake systems:**

1. **System operated Automatic Emergency Braking (SOAEB) :** Presently 3 units of SOAEB are working in one loco each in ELS/ TATA, RPM & AQ (31658/TATA from 23.03.18, 30366/RPM from 31.03.18 & 31368/AQ from 29.06.18) for field trial. The firm explained the functioning of SOAEB through a presentation for the knowledge of other Railways. The concerned ZRs were requested to send the performance of these units to RDSO so as to take further decision for its induction and retro fitment. As per the firm, these 3 units are working satisfactorily.
2. **Validation of Brake system to new spec 0126 :** The firm apprised that they will offer for prototype testing in August 2019.
3. **Standardization of VCD :** The firm stated that they had already tested the unit jointly with Railways after necessary rectification at ELS/RPM on 16.03.19 in loco-30631 (WAP7) successfully. Two additional pressure switches were provided in same line as 269.6/1 & 269.6/2 (Independent BC-PS). The firm is requested to give their proposal to RDSO for regular cut in and retro fitment of the added features.
4. **Provision of Auto Emergency Brake (AEB) :** The firm explained their proposal of AEB, However, they will require an input for speed from locomotive. This matter will be discussed later on along with the VCU and speedometer suppliers. However, M/s KBIL is of the view that the functionality of AEB can be made by VCU suppliers and Brake System only needs a signal for emergency brake when speed crosses the specified limit.
5. **Operation in PTDC mode :** The firm apprised that their prototype development and in house testing is completed and would like to make a fitment trial by 15.07.2019. During the meeting it was decided that fitment trial will be carried at ELS/RPM.
6. **Electronic cards:**
  - a) Improved Electronic Rack has been developed. Trial fitment and testing in one Locomotive has been done at ELS/RPM and found satisfactory. In-house testing of Pilot lot is under progress with Electronic Racks. Submission of test certificates of these new Electronic cards & Pilot lot of Electronic cards with Rack dispatched to ELS/GZB shall be done on priority.
  - b) For the possibility of Replacement by improved components during refurbishment of existing cards, the firm apprised that Study is under progress and trial will be planned in Oct'19.
  - c) Regarding the suggestion by ELS/GZB for provision of churning fan for cooling of cards, the firm apprised that their Center of Competence (CoC) have not recommended for such usage.
  - d) Regarding the tolerance during testing for voltage level at TP-9 point, the firm apprised that the matter is under review in new cards of new sources and will be circulated after finalization. Apart from this the firm has to study the reason why there is a variation in BP pressure values in DDS and Gauge.
  - e) Regarding usage of 6A fuse, the matter was deliberated and it was pointed out that normal current value in E-70 is around 4A while it is around 6 A in CCB. ELS/AQ and LGD stated that they were already

using 6 A MCB. CLW was requested to provide 6A fuse in new locos with E-70 as sheds pointed out that still 10 A MCB is being provided by CLW in locos having E70 units. RDSO has already issued advice to ZR's vide letter no EL/3.2.19/3-phase dated 22.9.2017.

7. **E-70 Valve assembly failures** : FTRTIL agreed to provide 20 sets of special tool to various sheds. 18 sets of special tools were dispatched to sheds namely ELS/BIA, ELS/HWH, ELS/SRC, ELS/CNB, ELS/LDH, ELS/KZT, ELS/RPM, ELS/Tata, ELS/BNDM, ELS/ED, ELS/BRC, ELS/NKJ, ELS/ET, ELS/VSKP, ELS/AQ, ELS/KLY, ELS/BSL & ELW/BSL. 02 more sets are ready and it was decided that they will be given to ELS/ GMO & TKD. Apart from this, a kit consisting of only Seals have been made by firm so that it can be replaced during TOH if required.
8. **Provision of Modified push rod in DBC** : 396 modified push rod has been provided to sheds. Further they have dispatched 300 more to their service Engineers to support whenever required. The firm told that the push rod of DBC having M1 mark should only be replaced.
9. **High Flow limiting valve** : Firm apprised that 58 Nos. delivered to ELS/GMO and 20 Nos. to ELS/GZB.
10. **Limiting valve** : The firm apprised that they have already provided improved valve stem to the sheds and they can provide additional valve stem as float stock if required by sheds . Sheds/ ZRs were requested to approach the firm for any further requirement. Sheds suggested that there should be some kind of marking to know in which valves this improved stem is to be provided. ELS/AQ also pointed out that in some cases of failures, they had observed that the Pin Hold provided in the pressure plate is not exactly in the center. The firm may look into the matter.
11. **CP Non Return Valve** : The sheds apprise that there are failures of CP NRV especially in new locos where the screw and plate ring is coming out. The firm has upgraded to use 263 Loctite instead of 242 Loctite. However, the sheds suggested to the firm to use hex bolt, spring washer and reduced thickness of plate ring in place of counter sunk screw and plate ring. This is similar to conventional loco CP NRV design that has less failures.
12. **Air Horn valve failures** : M/s FTRTIL apprised that defective Valve Stem was measured and found that the profile was not ok. Due to this the 'O' Ring is coming out from the groove when the valve is in operation. In the Measurement report 10 degree measures 6.41 degree one side and other side is found ok. Firm replaced the machining tool and corrective action taken from 30.07.2016. Replacement are being provided to Customers. As recommended by their CoC , Material is also changed from steel to Brass.
13. **D2 Relay valve failures** : Sheds reported Rubber seal for D2 relay valve is of 'NON-GACO' make received in 2018 is getting torn, part no 004701000A. M/s FTRTIL apprised that Pioneer Weston Seal Received 502 nos on Feb '2018 from FT UK as alternate source of Gaco, same were replaced in sheds after failures were reported. Since Gaco is going to close Alternate Source is under development. New seal will be implemented only after validation and feedback of performance from sheds. Total 8 Nos. of seal (5No.s in DBV, 2 No.s in D2 relay valve and 1 no in Brake way protection valve) fitted in ELS/AQ and performance is under monitoring. Firm is advised to provide more number of seals to other sheds for performance monitoring.
14. **Delay in inspection of material by RDSO** : Sheds reported delay in inspection of material by RDSO inspectors resulting delay in supply. It is not clear that why in inspection clause of POs, stores department of ZR's are mentioning the items under category II in terms of Rly Bd letter 99/RS(G)/709/1Pt.1 dated 11.03.2005 for items of E-70 or CCB brake system.

It is again clarified that in vendor directory issued by QA Elect directorate of RDSO, no categorization of items in terms of above Railway Board letter has been mentioned. This feature exists for material of

conventional brake system items as categorization of items in vendor directory of QA Mechanical is mentioned. Inspection by Rites/Consignee is only desirable for E-70 or CCB or its spares. This issue was discussed earlier also during meeting held at RDSO on 03.05.2018. The issue was made clear in MOM issued vide this office letter of even no. dated 08.05.2018. Zonal Railways were again requested to mention clause correctly to avoid delay in inspection.

**15. Misc. issues raised by sheds :**

SN	Reported Shed	Defect	Action Plan
1	ELS/KYN	One case FP pressure of 10 kg/cm <sup>2</sup> developed	Modified Feed valve performance is under monitoring.
2	ELS/HWH	Leakages from SA-9 valve. Diaphragm/seal are not setting properly and causing leakage.	The firm to look into the matter and provide feedback
3	ELS/HWH	Advised to add circlip in kit for 31/32 magnet valve.	
4	ELS/TKD	Advised to add circlip in the kit of Feed Valve.	
5	ELS/TKD	Split ring in stem of Double Check Valve is getting stuck up in new valves.	
6	All Sheds	To provide drawing of Modified Kaba key for procure.	CLW has now included this item in scope of supply of M/s FTRTIL. So ZRs may procure by part number.
7	ELS/HWH	Delay in lowering time of PT1 and PT2	ELS/AQ and TKD suggested that this problem can be solved by making the surface of pressure plate rough.
8	All Sheds	Sheds suggested to change Brake Cylinder Bogie and direct brake pressure switches settings from existing $0.65 \pm 0.05$ & $0.30 \pm 0.05$ to $0.70 \pm 0.05$ & $0.35 \pm 0.05$ kg/cm <sup>2</sup>	Regarding the query by M/s FTRTIL that the tolerance value should be changed from existing $\pm 0.05$ to $\pm 0.10$ . ELS/LGD apprised that they are easily able to adjust the settings within $\pm 0.05$ in less than 5 minutes. However they said they using 8 inches pressure gauges with range of 0-1 kg/cm <sup>2</sup> and least count of 0.005 kg/cm <sup>2</sup> . The firm apprised that due to variation in temperature the settings read at different ambient temperature will be different. To avoid value variations due to temperature it is advised to firms and ZRs to do the settings at controlled temperature of $27 \pm 5$ °C. Railways advised RDSO to review the SMI.

9	ELS/BRC and RPM	DBI PCB should also be included during refurbishment of Electronic cards and also in TC – 148.	The firm is advised to include the same.
10	ELS/RPM	Reported problem with operation of DBC handle- DBC handle is able to come out in between emergency and neutral position and causing air leakage from emergency exhaust port. This was demonstrated at the shop floor also.	The firm has to improve the handle design along with its locking screw.
11	ELS/AQ	FTRTIL 'O' ring part no 018701500 of D2 relay valve getting de-shaped in housing	The firm explained that this will not lead to failure as its function is to provide cushion but they will investigate and give feedback.
12	ELS/TKD	3 cases of 36 no coil of E70 valve assembly damage	Firm to investigate and give feedback.
13	All Sheds	Problem in getting toolkits and spares.	Firm has to share both hard and soft copies of catalogue of tools and spares to all sheds.

#### **B. Issues pertaining CCB brake systems :**

- 1. Problem of Emergency brake pressure SW reported by SER :** ELS/BNDM reported that problem has not occurred after the firm has changed BPCP and RCP.
- 2. Training of CCB to Loco Pilots :** Vide RDSO letter no. EL/3.2.19/3-Phase (CCB) dated 01.11.18, ZRs were requested that one hour slot during each refresher course to be arranged at ZTCs to impart training regarding CCB system by technical experts of M/s KBIL. ZRs are once again requested include lectures by engineers of M/s KBIL in their Induction and refresher courses of Loco Pilots.
- 3. Provision of brake interface unit for DPWCS :** DPWCS Interface & Dynamic testing completed satisfactorily with M/s ARCL equipped system in two Locomotives at ELS/Tata. Further refer MOM issued on meeting held at RDSO on 11.06.19.
- 4. Validation of Brake System as per RDSO's specification no. 0126 :** Lab test software received and can be tested at KBI works. Results already submitted w.r.t. TPS to RDSO.
- 5. Provision of Auto Emergency Brake (AEB) :** M/s KBIL stated that for this operation no unit is required. Only command for restricted speed is required to CCB system from VCU. KBI would advise IR to log the event of AEB operation in DDS downloads distinguishing clearly.
- 6. Provision of EM contactor for harmonic filter in place of EP contactor :** KBI along with MSI Italy is working on suitable EM contactor mounting and the same is expected by end of July 2019. The same can be tried out on loco in the month of Aug 2019.
- 7. Operation in PTDC mode with enhanced speed :** KBI apprised that they have supported ELS/LGD with material however the feedback for the same is awaited from LGD. ELS/LGD has already forwarded the matter for necessary modifications in software to CLW which is awaited.

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8. **Failure of check valves( CV and ACV) :** The firm apprised that to address the moisture entry in Aux panel, they have improved the filter housing and added one small reservoir to store moisture from aux compressor (fitted in Locomotives of RPM – (30424 & 30417), KYN – (31473, 31551 & 31590), LGD – 31474 & 31618), so that moisture developed from Aux Compressor is collected at the entry of the Aux Panel. They have also modified the Check Valve cap (as suggested by IR) as mentioned to avoid getting stuck. They have sent 75 nos of Modified check valve guides to Electric sheds and would be able to fit based on the availability of the locomotive. As on date 59 nos out of 75 nos have been replaced. ZRs are requested to monitor the performance and provide feedback to RDSO.

They arranged an Air Dryer for Aux Compressor and tested at ELS/Tata. However, pressure setting for the purging has to be set properly. They will send the same to ELS/KYN under trial once setting is done as decided in the meeting.

9. **Aux reservoir drain arrangement :** KBI has modified the Reservoir Drain Handle which will be extended outside for proper visibility and also going to provide an indicative sticker for the same by end of June-2019. M/s KBIL apprised that out of 230 locos , 45 nos have been sent. They have to ensure to provide stickers also (02 for cab and 01 at panel).
10. **Failure cases of EBV :** M/s KBIL apprised that matter is under investigation and being consulted with NYAB.
11. **Pressure switches failure :** Mainly failures of PAN-PS switch are there, which will get resolved after implementation as discussed in point # 8 above.
12. **Provision to change Pneumatic supply for ULV, TC1&2 and FC-Coc :** The firm has supplied 09 nos retrofit kits ( KYN-3, RPM-1, LGD-2, TATA-2, TKD-1). ZRs are requested to monitor the performance and provide feedback to RDSO for further decisions.
13. **Failures of feed valve :** After receiving satisfactory field trial performance from sheds, vide letter no. EL/3.2.19/3-phase/CCB Dt. 27.03.2019, RDSO has advised to firm for supplying new check valve of feed valves to the electric sheds. Accordingly, they have supplied 400 nos to sheds and already fitted in 127 Locomotives. Balance qty will be arranged by July-2019.
14. **Provision of terminal covers on terminal block in (Wiring junction box) :** The firm apprised that out of 733 locos , 340 locos completed and implemented from May'19 onwards with new supplies.
15. **Push pull operation with WAP5 locomotives :** Push Pull operation checked at ELS/TKD & ELS/GZB with WAP7 & WAP5 Locomotives and no issue observed.
16. **Failure of Auto Drain Valve :** KBI has improved the design and provided a seal in between metal to metal contact within Auto Drain Valve so that the excess breathing which was leading to leakage is addressed. KBI has already provided one modified Auto drain valve seal in 30410/RPM Loco on 06.06.2019 that is under trial. RDSO advised to provide some more seals for trials at ELS/GZB, AQ, LGD, RPM and KYN. ZRs are requested to monitor the performance and provide feedback to RDSO.
17. **ERCP failures :** KBI explained about fault code 125 & resetting procedure. However, KBI has to provide investigation report, corrective and preventive action for ERCP leakage.

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# 18. Issues reported by Sheds :

SN	Reported Shed	Defect	Comments
1.	ELS/ RPM	Air leakage from KE valve- "u" port observed in 02 locos.	The firm has to investigate and provide feedback.
2.		MOH & IOH kits for CCB system to be given by M/s KNORR. This problem was also reported by ELS/GZB, BRC, LGD, KYN.	<b>M/s KBIL stated that overhauling of LRUs shall be done by OEMs since it involves skill, which sheds may not have. For rest of the items spares shall be supplied.</b>
3.		In case Configuration mismatch message logged, not able to find which one of the EBV mode in wrong position. Further details required.	The firm explained normally this fault will log when one EBV already in LEAD and other one also made LEAD and the one which was left in LEAD position only while making the other cab as LEAD is a wrong position. Point was clarified and closed.
4.		Downloaded data of CCB are insufficient, more event logging is required.	All the pressure values are available in CCB download at the time of fault log. However, for more events logging, there should be a separate Event Recorder facility in the Locomotive. CCB can continuously provide feedback of critical pressures like BP, BC to Event recorder like in HHP Diesel Locomotives.
5.		Downloading time not matching with DDS.	Date and time in CCB is settable from KBI Engineer's Laptop through PTU tool and is exactly as per Indian Standard time based on GMT time. Further, their Engineer cannot alter the settings. Sheds can maintain IST timing then both DDS & CCB will have same time. Point was clarified and closed. ZRs are requested to carry out a drive to correct time/date in their CCB fitted locomotives.
6.	All Sheds	Sometimes Compressor MCB 47.1/1 and 47.1/2 tripping especially after passing neutral section.	Sheds have to ensure Type-D MCBs. ELS/GMO reported that they using them and no such problem. CLW is also requested to ensure in new supplies.
7.	All sheds	Transient failures where fault in VCU or CCB Brake system could not be identified. Spurious Brake Electronics messages and DBI signal. Booting time issue with BHEL locos.	ZRs are requested to get these matters investigated jointly with KBI and VCU engineers. KBI also has to investigate these matters to resolve these issues.
8.	ELS/AQ	Failures due to leakage from NB-11 or EEV	The suggestion is pertaining to

		can be avoided by using dummy plug.	operations hence ZRs may take suitable decision at their end. The firms also agreed that as such there is no problem for clearing the section ONLY by using dummy plug by LP/ALP.
9.	All sheds	Sometimes after switching off MCB 127.7 , panel does not go off.	The firm apprised that this failure does not lead to failure at line and it happens due to diode failure. Spare diodes will be provided to all sheds.

### **C. Common issues pertaining to E-70 and CCB :**

- 1. Pressure gauges :** ELS/RPM reported Frequent failures of AFI gauges specially of M/s Midland make. ELS/KZP,GMO,GZB & RPM reported 02, 05, 04 & 04 cases of bourdon tube leakage in CPA pressure gauge (Make Faiveley) respectively due to poor brazing quality. Another new problem of LED not glowing was mentioned during meeting. Like this all sheds reported problems with pressure gauges that were already elaborated during meeting at RDSO on 16.01.19 whose MOM issued vide letter dated 25.01.2019. Vendors of both firms i.e. M/s TOPGRIP & M/s MIDLAND were present and they explained the improvements they are carrying. They agreed to supply 2-2 pointer pullers to each shed. The problems with the gauges were demonstrated at the shop floor also. Regarding LED not glowing the manufactures apprised that in CLW drawing it is mentioned that rated voltage is 24v – 110 V that does not seem to be correct.
- 2. Induction of better gauges :** Both the suppliers of Brake system and their vendors of pressure gauges were again requested as in MOM 16.01.2019 which is reiterated below :

- “It has been observed that the main contribution-of shed arising related to brake systems over IR is due to failures of pressure gauges. Hence, the brake system suppliers are requested to explore more sources to supply better models of reliable gauges that can be put on for field trials.
- Suppliers of pressure gauges should also develop better type of gauges that can be put on for field trials.
- For this purpose, deviations from existing CLW drawings can be considered if performance/feedback from ZRs is found satisfactory.
- Already M/s TOPGRIP INDUSTRIES, Hyderabad, during meeting held at RDSO on 19.12.18 shown a presentation of better type of pressure gauges having both digital & analog display of readings and proposed for use in electric locomotives for MR+FP, BP, BC1+2 & AFI in a cluster of 04 gauges as per existing arrangement. It was discussed to provide one set of the gauges in one WAG9 loco at ELS/TKD replacing the existing gauges for field trial purpose. Brake system suppliers were also advised to submit their proposal to RDSO for provision of this set of gauges to be fitted in two WAG9 locos based at ELS/TKD having CCB and E-70 brake system respectively for field trial and to monitor performance.”

M/s Faiveley presented one of their sample of Faiveley make imported gauge but for LED it requires 110 V which is to be changed to 24 V DC. They requested one loco for trial. Hence, ELS/RPM is requested to facilitate the firm for providing in one cab of one loco during TOH/IOH. Its performance is to be monitored.

M/s TOPGRIP demonstrated their product with cluster of 4 gauges which was appreciated by sheds engineers. They also explained other features which can be added like event logging, counters for VCD penalty, remote telemetry of pressure values, memory for 30 days etc ..

Both the brake system suppliers are once again advised to improve quality of their vendors of gauges and bring better makes/sources.

*JK*

3. **Air Horns** : Failure of air horn is much more in E-70 in comparison to CCB. In E-70, their vendors are M/s ELGI and it comprises of a brass diaphragm which often get burst. M/s FTRTIL said that they have developed an overhauling kit. In CCB, their vendors are EIW and RECON and air horn has Hylum sheet diaphragm which fails less but not zero and there is no maintenance kit as such. M/s FTRTIL and M/s KBIL are advised to improve their vendor's quality or change to other vendors providing reliable product under intimation to RDSO.
4. **Proportionate brake application in train in case of regenerative braking failure** : CELE/NR has raised the issue that during failure of regenerative braking only loco brakes are applied without BP drop and there is likely-hood of wheel skidding. This matter was discussed with all the sheds engineers and they reported that no such case has come into the notice. However they will keep a watch and give feedback to RDSO.
5. **Failure of EATON make pressure switches** : CELE/NR apprised RDSO that failure rate of Eaton make pressure switches is higher than Square-D type pressure switches. The matter was discussed with all shed engineers, most of them agree with CELE/NR's comments. M/s FTRTIL and M/s KBIL are advised to look into the matter and give their comments to RDSO.
6. **Revision required in TC-113 and TC-116** : Feedback from Railways is still awaited. ZRs are requested to send their proposals for changes in these TC's.

**D. Performance of Sheds (As provided by sheds):**

**Five Electric Loco Sheds with least FRPCPY of brake system in ascending are as below :**

E-70				CCB			
Sheds	TOTAL Failures	Population of E70	FRPCPY(18-19)	Sheds	TOTAL Failures	Population of E70	FRPCPY(18-19)
HWH	6	50	12.00	BNDM	0	22	0.00
KZJ	3	17	17.65	KZJ	9	34	26.47
BSL	3	14	21.43	LGD	10	33	30.30
LGD	42	167	25.15	VSKP	37	91	40.66
AQ	64	179	35.75	TKD	31	65	47.69

**Five Electric Loco Sheds with highest FRPCPY of brake system in descending are as below :**

E-70				CCB			
Sheds	TOTAL Failures	Population of E70	FRPCPY(18-19)	Sheds	TOTAL Failures	Population of CCB	FRPCPY(18-19)
NKJ	25	6	416.67	GZB	287	56	512.50
GZB	595	156	381.41	SRC	11	6	183.33
CNB	62	23	269.57	BRC	42	24	175.00
BRC	110	76	144.74	CNB	31	19	163.16
GMO	134	150	89.33	KYN	51	33	154.55

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