



TRACK MACHINE DIGEST

रेलपथ मशीन पत्रिका



*Indian Railways Track Machine Training Centre
North Central Railway, Prayagraj, Uttar Pradesh*



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Editorial Board



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Editor's Message

Dear Readers,

I feel pleasure to put new addition of Track machine digest for you people. Track maintenance machinery is the leading segment, propelled by the increasing focus on track safety and performance. Track machines have become indispensable for Track maintenance not only by choice but compulsion. Track machine staffs supposed to gain quick knowledge of latest technology for effective operation and attention of failures in field. Technological advancements are playing a pivotal role in shaping the market landscape moreover continuous advancement of technology creates opportunities to increase machine efficiency. The integration of AI technologies in maintenance machinery are revolutionizing predictive maintenance practices. These innovations enable real-time monitoring and data analytics, minimizing downtime and reducing maintenance costs. This addition is attributed to modern digital diagnosis system and depth analysis of overheating of hydraulic system with practical approach to handle the situation. The global push towards reducing carbon emissions is prompting Railways to focus on energy-efficient and eco-friendly maintenance practices. This trend is fostering the development and adoption of machinery that aligns with green initiatives and enhancing global Track machine's growth and potential to meet out the need. Additionally, the increasing volume of freight and passenger traffic is necessitating regular track inspections and maintenance, further bolstering the demand for advanced machinery solutions. We have also initiated some new segments in digest for Hindi poetry and glimpses of recent improvements as well as praising the batch toppers in various long duration courses. Your feedback and contribution of Track machine related contents are always welcome to make this digest more useful and knowledge sharing.

With Best Wishes,

Sanjay Asthana
Principal/IRTMTC

Disclaimer: "The views expressed by the authors of technical papers in this digest are not necessarily the views of IRTMTC or North Central Railway."

Design lining by collecting Track Data with Portable measuring trolley: A new concept

-By
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1. General

The continuous development and improvement of track maintenance machines has led to a range of designs for all applications that not only fulfill the high demands of accuracy for high-speed Railways but also provide cost-effective solutions, either by increasing the working speed or by implementing latest technologies. New high technology machines contribute to the sustainability of the investments in high-capacity passenger lines as they provide a high level of maintenance. Tamping machines can produce the track geometry very precisely according to the design. Traditional machines only take into account the relative track geometry such as horizontal curvature, vertical inclination and cant. The absolute track position and the correction values compared to the nominal track position cannot be determined. However, to position the track absolutely correct, correction values can be transferred to the machines for lifting and lining (absolute method). The measurement related to the fixed points of these correction values is also named pre-measurement for tamping. Geodetic pre-measurement with total station and track measuring trolley (e.g. Trimble GEDO Track) and Pre-measurement with a twin-trolley system using the long chord measurement method (e.g. Trimble GEDO) are the two main measuring systems being adopted universally. GEDO



IMS as a highly productive system based on Inertial measurement technology for long distances. The respective field software guides the operator to ensure complete and accurate data capture. The main points are displayed during the measurement and the user already in the field about the deviation from informed about the target track position. This is done using the GEDO Office software. Data processing, analysis, data preparation for the Tamping machine and the creation of quality reports.

2. Machine details

The system utilizes Differential Global Positioning System, (DGPS) which uses ground-based reference stations (static point & temporary bench marks) to correct errors in Global Navigation Satellite System (GNSS) signals, which improves the accuracy of the resulting position data. Along with DGPS, this system of recording pre-measuring tamping data also utilizes Total Stations, inertial measurement, and related sensor technologies to capture precise positioning

data on Railway track and surrounding features. Various instruments used in this system is detailed below:

A. Total station

The **Total station** used in this system integrate the best field technologies plus the highest level of accuracy and specialized engineering features for the ultimate in performance and precision. Using this, we can combine scanning, imaging, and surveying into one solution,



or focus on the highest level of accuracy with available options. Back in the office, the 4D office software helps us process and analyze the collected data. It also allows us to direct the survey with the help of live video images on the controller, enabling a wide variety of deliverables from collected imagery. It is available up to an accuracy of 0.5" (0.5 seconds) angular measurements.

B. Pre-tamping measuring trolley

Fast, accurate measurement of track conditions is a key component of productive tamping operations. It provides adjustment data to tamping machines quickly and efficiently, avoiding costly idle time for ballast tamping machines and work crews. Precision measurement systems make this pre-measuring recorder trolley a crucial tool in conventional and high-speed rail tamping. The trolley is a suite of tools for measurement, recording,

analysis, and applications for railway track location, construction, and maintenance. Specially tailored for railway tasks and processes, the Trimble GEDO CE trolley (as shown in figures) hardware and software streamline work in the field and office. The system uses standard techniques and data formats to share information with leading applications for railway track design and maintenance. Figure below shows a pre-tamping measuring trolley with total stations mounted on it.

Track Parameter measuring trolley are track geometry measuring trolley are available with Make of (Trimble / Amberg etc.) Main features of this machine are: Compact device, Measurement of the rail track geometry (level, track gauge, horizontal and vertical deflection of track. Normally known as **UGTA** in field which is full form of unevenness, gauge, twist & alignment), Real time data transmission using satellite navigation system.

C. Controller

The Trimble pre tamping measuring system comes with a TSC7 Controller which is a wirelessly connected, rugged handheld controller for GNSS or total station operations. It gives construction surveyors, or site engineers total control over their on-site tasks for regular maintenance activities of track. It offers integrated Wi-Fi and Bluetooth, built-in cameras, and GPS in a lightweight, shock, dust, and water-resistant package. temperatures. With its Windows 10 operating system, the TSC7 can run third-party applications as well as Trimble Site

works Software. A construction surveyor or grade checker can receive the design model, create new measurements, and then send the measurement and stakeout results back to the office for review. Design changes happening in the office can also be sent to the controller so field crews are rapidly updated with current information.

3. Data collection system

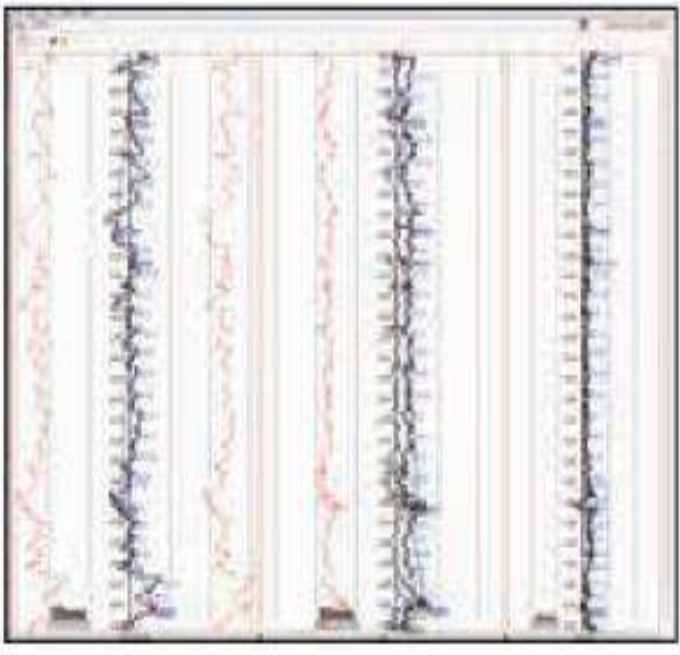
This system of design lining relies on various technological systems. With the profiler, the lateral offset of the track center line and the height offset to the top of the reference rail are determined at the reference point. If the design values at the reference point are compared with the as-built values, the lift and shift values at this track position are identified. In addition, the reference point measurement serves to locate the track measuring trolley, i.e. at which chainage on the track it is currently

according to a design are generated for each point of the trajectory. These can be used as the data source for the automatic guidance of a tamping machine. Analogous to the twin-trolley system, reference points may also be skipped so that productivity increases, but also the basic idea of the long chord method is fulfilled. Data collection in this system is in various stages. These stages are briefly dealt below:

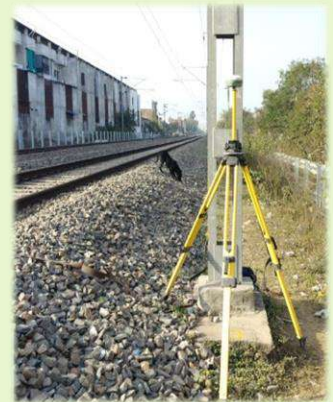
A. Data from DGPS

DGPS stands for Differential Global Positioning System. It is a system to find the absolute location of a point on the Earth surface. The exactness of this system depends on DGPS to a much larger extent.

DGPS system uses one base and two rovers for locating the actual co-ordinates of every chainage of the track to be measured as shown in two figures below. The marking of base is done on some trolley



located. If two successive reference points were measured in this way, the trajectory can be measured between these two points with the IMU. By combining measurements, lift and shift values



refuge or OHE mast (structures other than track which are fixed on the ground and are available readily at all points). Minimum 06 manpower is required in this step to locate various points which are going to be vital for pre-tamping measuring of track parameters.

After mounting the base, data collection is done in two steps. The first step is to mark the static points and then in the next step, marking of temporary

bench marks (TBM) is done. These are briefly discussed below:

B. Data from static point

Static points are marked at intervals of approx. every 04KM from the base along one direction of track. Normally, 20KM of track locations can be marked per day using DGPS. Static points markings using 02 rovers takes 01 day in the DGPS located track length.

C. Data from temporary bench mark

After marking of static points at fixed structures like OHE/Trolley refuges etc. at intervals of every 04KM, next step is to locate and mark the temporary bench mark point or TBM points. These TBM points are marked at intervals of every 150m. These TBM points can be marked up to 10KM from base in each side.

The static points are kept under 02 hours cyclic observation and TBM points are kept under 03 minutes cyclic observation using satellite. This observation helps in identifying Northing, easting, and elevation which are the values that can be used to identify a location on a map or in a spreadsheet.

D. Data from pre-tamping measuring trolley

As discussed in section above, the pre-tamping measurement is taken with the help of trolleys (GEDO Trolleys). There are two trolleys- Totals stations (TS) trolley and prism trolley. Trolley with TS is kept at starting TBM and trolley with prism is kept at next TBM and hence both trolleys are 150m distance apart. The TS trolley keeps on taking the existing track measurements while moving on track towards the prism trolley. Likewise, measurements are taken

for existing track from one TBM to the next. These trolleys keep sending data to the controller about which we have discussed in detail above. The trolleys are operated by minimum 03 persons. Approx 5KM of track length is recorded by these trolleys per day.

4. Raw data

The raw data are compiled using software and following three types of files are generated:

a. Geometry file: This file contains the details about the geometry of track with which it is laid. Geometry includes straight track, reverse curve, full curve

b. Versine File: This file contains the shifting/lifting values for correction of track. This value is calculated based on recorded data of existing track and the target geometry of track that is desired.

c. PDF File: This file contains above data of track in pdf form for checking synchronism of the shifting/lifting values for correction of track. During machine working, this file will come into role for matching the chainage of actual work location with the chainage of current location as shown in ALC.

5. Feeding procedure in ALC

It is advanced computer software loaded on on-board computer, which automatically calculates target output for the lining, levelling and cant based on manual input of required track geometry or measuring run data. The alignment, cant (SE) and level (gradient) are also displayed on the computer screen.

1. The files as mentioned in previous section are to be fed in ALC as geometry file

and as shifting and lifting value file. Left over details as per target geometry is also being calculated by the system.

Pole no.	P H	Position	Slue	Uplift	(Target)	dCant	Gauge	Degn Ver	Degn Cant
		1232.9+85.00	-> 24	12	(-44/0)	2	1669.5	0	0
		1232.9+90.00	-> 27	14	(-50/0)	2	1668	0	0
		1232.9+95.00	-> 28	15	(-55/0)	-1	1667.9	0	0
Ch_1233/000	< >	1233.0+00.03	-> 32	20	(-61/0)	-5	1668.8	0	0
Ch_1033/000	< >	1233.0+00.03	-> 33	22	(-61/0)	-5	1668.8	0	0
		1233.0+05.00	-> 33	24	(-67/0)	-6	1669.3	0	0
		1233.0+10.00	-> 35	27	(-72/3)	-7	1669.4	0	0
AA		1233.0+13.52						0	0
		1233.0+15.00	-> 35	29	(-78/7)	-7	1669.3	0	0
		1233.0+20.00	-> 38	29	(-82/-13)	-8	1668.7	0	0
		1233.0+25.00	-> 41	31	(-83/-19)	-9	1669	0	0
		1233.0+30.00	-> 42	36	(-83/-24)	-8	1669	0	0
NW		1233.0+32.08						0	0
		1233.0+35.00	-> 43	42	(-83/-27)	-10	1667.7	0	0
		1233.0+40.00	-> 41	46	(-82/-27)	-15	1668.5	0	0
		1233.0+45.00	-> 36	40	(-82/-27)	-20	1668.8	0	0
1233/2	< >	1233.0+46.26	-> 34	37	(-82/-27)	-22	1668.5	0	0
		1233.0+50.00	-> 28	41	(-80/-27)	-20	1668.2	0	0
AE		1233.0+50.64						0	0
UA		1233.0+51.27						0	0
RA		1233.0+51.27						0	0
		1233.0+55.00	-> 25	38	(-73/-27)	-17	1667.7	0	0
		1233.0+60.00	-> 22	36	(-66/-26)	-16	1667	0	2
		1233.0+65.00	-> 16	34	(-59/-24)	-12	1667.4	-1	3

2. We can find out the exact shift and lift value as per exact location where the tamping machine is to start the design

Curve No 9 R 10294 SE 20 TL 60							
STN	Chainage [m]	Horizontal Versine, 20m chord [mm]			Cant [mm]		
		Design	Measure	Deviation	Design	Measure	Deviation
0	1233051.265	0	-3	3	0	20	-20
1	1233061.265	0	-2	2	2	18	-16
2	1233071.265	-1	-2	1	5	16	-11
3	1233081.265	-2	-4	2	8	23	-15
4	1233091.265	-3	-2	-1	12	19	-7
5	1233101.265	-4	-4	0	15	19	-4
6	1233111.265	-5	0	-5	18	19	-1
7	1233121.265	-5	1	-6	20	20	0
8	1233131.265	-5	-4	-1	20	18	2
9	1233141.265	-5	-3	-2	20	18	2
10	1233151.265	-5	-6	1	20	17	3
11	1233161.265	-4	-2	-2	17	12	5
12	1233171.265	-3	-1	-2	14	10	4
13	1233181.265	-3	-5	2	10	8	2
14	1233191.265	-2	-2	0	7	5	2
15	1233201.265	-1	2	-3	4	-1	5
16	1233211.265	0	2	-2	0	-7	7

lining work with machine ALC.

Pre and post correction data including deviation may be seen in tabular format with unique traceability of chainage.

6. Results

A. The result of these measuring methods is always the deviation of the current track position from the nominal geometry in a continuous grid. These

values can be viewed in detail and prepared for the tamping machine. In this way, the final track position is defined, which is then to be produced by the machine. External parameters such as maximum shift, minimum and maximum lift as well as constraint points in the existing track are considered.

B. Tamping work can begin without delay immediately after the digital data has been loaded. In addition to the lifting and lining values, the geometry information can also be transferred from the measuring system to the tamping machine. This digital data exchange prevents manual transmission errors and ensures that the same information is used as a reference for both the measurement and the machine work.

Final track geometry attainment:
Following steps may guide for attaining final track geometry.

1. Setting up base station either by Taking observations with DGPS (Differential Global Positioning System).
2. Setting control points –
 - Primary control points – 10-20 km (optional).
 - Secondary control points – 1-2 km (by Total Station)
 - Tertiary control points – 150 -200m (OHE mast Foundation) (by Total Station) Taking centre line coordinates of Laid track either by Total Station or Track Geometry measuring Trolleys (Trimble/Amberg etc.)
3. Transferring centre line alignment data to regression software i.e. Bentley Open Rail, Civil 3D, GEDO etc.
4. Designing best fit alignment and vertical profile which solves the needs of high speed and high accuracy.

5. Comparing existing centre line coordinates with designed alignment and profile coordinates and get slews (FD) and lift (Y) value for tamping machine.
6. Transferring Slew (FD) & lift (Y) values in ALC of tamping machine.
7. Before tamping synchronise tamping machine at known chainage or opposite one of the tertiary control points.
8. Doing 1st round of tamping.
9. Taking centre line alignment /profile data by doing centre line coordinate survey again.
10. Comparing this alignment and profile with design alignment and get slews (FD) and lift (Y) values.
11. Doing second round of tamping after transferring slew (FD) and lift (Y) values to ALC of tamping machine duly synchronizing tamping machine.
12. Repeating steps 4-9 in and do 3rd round tamping, if required.
13. Taking centre line coordinates again and compare with design alignment (difference should be within acceptable limit).
14. Taking as built alignment for reference and record.

7. Limitations

A disadvantage of the system lies in the drift to which the individual IMU sensors are subjected. In this case, drift means that a motion or rotation is detected even though the system is at rest in reality. These drift increases exponentially with continuous duration and leads to an increasing deviation from the actual position. This is countered by measuring synchronization points whose coordinate position is known and thus correcting the drift at regular intervals depending on the absolute accuracy required.

Due to various obligatory points and implantations, accurate targeted geometry of track is practically not feasible due to SOD infringements and local alterations.

8. Conclusion

Tamping is essential for Railway maintenance to ensure Track quality and stable ballast. Trimble GEDO provides an integrated solution for measurement and quality control to support tamping machines and operations. The Trimble GEDO track measurement trolley is used to capture the existing track geometry. Measured data is quickly analyzed and prepared for output to tamping machines. The ballast volume can be planned for the respective route sections. After the tamping work has been completed, the Trimble GEDO track measurement trolley is used to carry out a track re-measurement to ensure that the work has been carried out correctly.

Despite of constraints in laid track, transferring of field data to machine ALC is extremely useful and effective. This system serves as correction of track with elimination of long chord error which is extremely essential for high speed Track geometry. The statistical calculation of Trimble GEDO Track includes regression analysis of the track measurement data and the conversion into alignment elements. It offers several scenarios for adapting elements to the existing track position. Using robust regression methods, parameters of the individual elements are determined and optimized through a calibration process.

Overheating of Hydraulic oil in Hydraulic system of Track Machine

-By
Sanjay Asthana
Principal/IRTMTTC

1. General

Heat has many detrimental (harmful) effects on the hydraulic system components. But the most detrimental effect of heat is the breakdown of the oil. Oil temperatures should be maintained at 120°F (48-50 deg C) for optimum performance, and should never be allowed to exceed 185°F (85 deg C). At high temperatures, oxidation of the oil is accelerated. This oxidation shortens the fluid's useful life by producing acids and sludge, which corrode metal parts of machine causing silt contamination. These acids and sludge clog valve orifices and cause rapid deterioration of moving components. The chemical properties of hydraulic fluids can change dramatically by repeated heating/cooling cycles to extreme temperatures. This change or breakdown of the hydraulic media can be extremely harmful to hydraulic components of Track machines. In view of this we can say temperature is the enemy of hydraulic system.

2. What is hydraulic oil?

Hydraulic oil is a non-compressible fluid that is used to transfer power within hydraulic machinery and equipment. Hydraulic oil can be synthetic- or mineral-based. Although this useful fluid is commonly used in the transfer of power, hydraulic fluid can act as a sealant, coolant and lubricant within machinery and

equipment. Otherwise, it is also known as hydraulic fluid, Hydraulic fluids are specially formulated fluids that are used in hydraulic systems to transmit power. Hydraulic oils, meeting the DIN 51524-part 2 standard, are available in three ISO viscosity grades (ISO 32, 46, 68) They are formulated to meet the specific requirements of hydraulic systems, which typically operate at high pressures and temperatures. Hydraulic fluids contain various additives that provide following properties:

- high lubrication reliability-
- outstanding corrosion protection-
- outstanding thermal stability, within a range of operating temperatures
- high resistance to aging-
- does not attack common sealing materials-
- excellent wear resistance
- anti-foaming
- anti-oxidation
- Non-compressible
- Fire resistance
- Non-corrosive to its system
- Anti-wearing to its system
- Low tendency to cavetti
- Tolerance to water (resistance to water contamination)
- Total water rejection
- Constant viscosity, regardless of temperature
- Long life
- Cost-effective

3. The main difference between synthetic and mineral-based hydraulic oil

Mineral-based hydraulic oils are derived from crude oil fractions whereas synthetic hydraulic oils are made using chemically produced base fluids.

Synthetic oils can be formulated to impart superior physical properties in comparison to mineral oils, for example, high-temperature performance, biodegradability, and oxidation stability.

Bio-based hydraulic oils: These are made from renewable resources such as vegetable oils and animal fats. They are biodegradable, making them a more environmentally.

The majority of oils which are produced are either mineral-based or synthetic.

4. How do hydraulic systems work?

The key role of hydraulic oil in a hydraulic system is to transfer power from one end of that system to another end through and the various hydraulic components. When an external force is applied to the non-compressible hydraulic fluid – usually from a piston within a cylinder – the oil is pushed through the hydraulic system and ultimately produces a force on another part of the system. This results in a movement or action. Usually applying force to material results in compression, so you may be wondering whether hydraulic oil is compressible or not, but a key property of hydraulic fluids is that they must be non-compressible. ‘Non-compressible’ means that the fluid cannot be compressed. Liquids are compressible to some degree, but it is

incredibly negligible and not considered for our guide. In contrast, gases are compressible, and so are not used in hydraulics.

5. The contents of hydraulic oil

Hydraulic oil is made from a variety of different ingredients, with one base fluid. These ingredients can often be mixed depending on the type of oil you require. Generally speaking, hydraulic liquids are made up of:

- Mineral oil
- Esters
- Glycol
- Silicone
- Ethers
- Some other chemicals which are hard to pronounce!

For the varied applications of hydraulic fluid, blenders will mix the base oil with additives of different types to make the properties of hydraulic oil different.

6. Condition based use of Hydraulic oil

A. Hydraulic oil for winter

Hydraulic power is required in some of the coldest places on earth. In these cases, anti-freeze additives are used to prevent the fluid from freezing up or waxing. Low-temperature hydraulic oil is commonly used as a name for fluid which needs to be used in icy conditions.

B. Hydraulic oil for high-heat applications

Under high heat, oil becomes less viscous and flows more easily, which means that it can leak or lose its required

properties. Additives are used to retain viscosity for fluids used in applications involving exposure to higher temperatures.

C. Hydraulic oil for heavy-duty use

Heavy-duty hydraulic oil is necessary for high-pressure environments where the fluid needs to be able to cope with large amounts of stress. The hydraulic oil additives used here will typically contain anti-wear properties. Anti-wear hydraulic oil is one of the most common blends used in industry and construction.

D. Environment-friendly hydraulic oil

Biodegradable hydraulic oil is used in applications where an oil spill or leak could potentially contaminate the environment. The typical base oil for biodegradable versions of hydraulic oil includes rapeseed oil and some other vegetable oils. Environmental hydraulic oil is a strong consideration for those using hydraulic machinery on farms, forests, or similar environmentally sensitive sites. This is because the oil is made of a biodegradable base fluid so it will degrade naturally in the event of a spill.

7. Hydraulic oil ratings

When an additive company sells an additive pack, it will work alongside a particular manufacturer to create a product which works perfectly with that manufacturer's application. This will be traceable by a hydraulic oil supplier who has used the additive in the fluid. Hydraulic oil ratings or approvals are stipulated by many end users of oil to ensure they're using the correct fluid for their equipment.

8. Hydraulic oil analysis

Commonly known as condition monitoring, a hydraulic oil analysis service is used by people who want the most out of their oil before they must change it in their hydraulic application. This works by sending a sample of the hydraulic oil to a lab which analyses the sample and reports back with details as to whether it is good to use further or if it needs to be changed. Following is a list of just a few reasons why it should not be ignored and how it pays for itself many times over:

- Reduces the cost involved in replacing the oil prematurely.
- Minimize damage to your machinery by identifying issues early.
- Has the potential to enhance the life and performance of machinery.
- Reduces the risk of damage to machinery and products.
- Reduces the risk of injury to people and further costs in claims and damages.

9. Hydraulic oil viscosity

When it comes to hydraulic oils, viscosity is the measurement of its resistance to flow and it is an important property of hydraulic fluids. This means the fluid will resist compression at different rates depending on its viscosity and take longer to pass through an orifice as the viscosity increases. Hydraulic fluid with high viscosity will be thicker and harder to compress and move as opposed to low viscosity hydraulic oil which will be thinner and pass through easier. The viscosity of a hydraulic fluid is measured in Centistokes (cSt) and usually at temperatures of 40°C or 100°C. The value will always have the temperature next to it as without this the value will be meaningless.

9.1 Viscosity of hydraulic oil vs temperature

The viscosity of hydraulic oil and temperature is closely linked. As temperature increases, the viscosity of the oil will decrease – a bit like when you put cooking oil in a cold pan it moves slowly but when the pan heats up the oil moves around very quickly and with ease. As the temperature drops hydraulic oil will become more viscous. Blenders are always trying to make hydraulic oil operate effectively over a wider range of temperatures. This means they will go down to low temperatures and still work as effectively as the temperature increases.

9.2 Hydraulic oil viscosity index

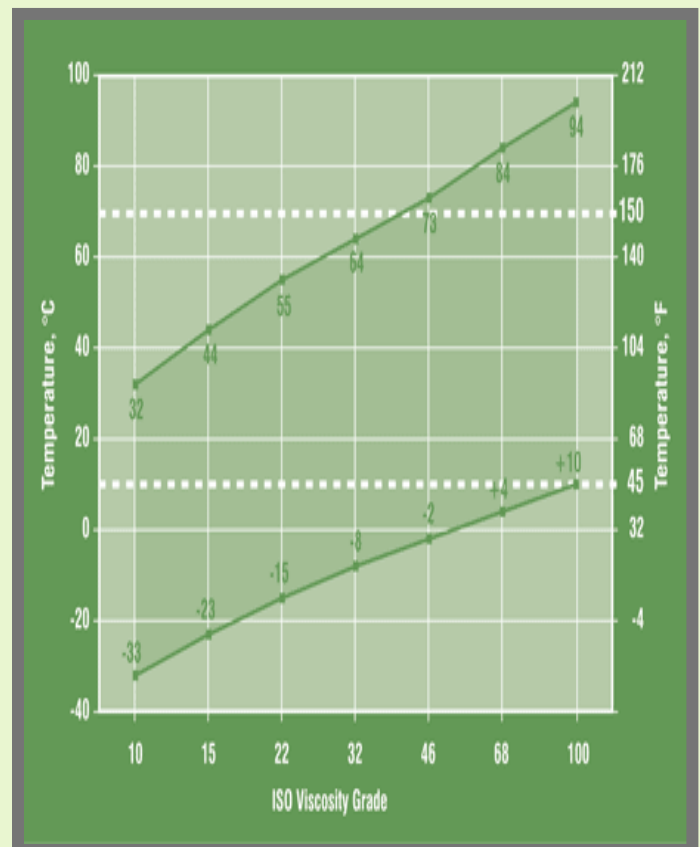
To measure the change in viscosity of hydraulic oil when the temperature changes, we use the oil viscosity index (VI). If hydraulic oil has a low viscosity index, a temperature change will alter the viscosity more than if it has a high viscosity index. Hydraulic oil with a high VI will usually be required in an application which is subjected to a greater range of ambient and/or operating temperatures. The greater the value of the V.I. the smaller the change in viscosity for a given change in temperature, and vice-versa. A straight paraffinic mineral base oil will typically produce a fluid with a low viscosity index, whereas a paraffinic mineral base with viscosity improvers will produce a fluid with a high viscosity index. The SAE (Society of Automotive Engineers) created a classification table (VI Scale) to show low to high viscosity levels depending on temperature °C. Originally the scale only went up to 100°C but with advances in

hydraulic oil blends, the scale now goes above this number!

S.N.	Viscosity Index	Classification
1	0-35°C	Low
2	35-80°C	Medium
3	80-110°C	High
4	110°C and greater	Very High

9.3 Hydraulic oil viscosity conversion chart

There are two measures of viscosity: absolute (also known as dynamic) and kinematic. The S.I. unit for absolute viscosity is Nsm^{-2} or Pas. The non-S.I. unit is the *poise* (P) equivalent to 0.1 Nsm^{-2} (not to be confused with the 4 Poiseuille (*Pl*), used in France, and equal to 10 poise) though the centipoise (cP) is more commonly used.



Absolute viscosity is equal to Dynamic viscosity divided by density of fluid. The S.I. unit for kinematic viscosity (ν) is mm^2s^{-1} which corresponds to the older but still commonly used unit the centistoke

Table 1. ISO Viscosity Classification

ISO Viscosity Grade	Midpoint Kinematic Viscosity mm^2/s at 40°C (104°F)	Kinematic Viscosity Limit mm^2/s at 40°C (104°F) Minimum	Kinematic Viscosity Limit mm^2/s at 40°C (104°F) Maximum
ISO VG 2	2.2	1.98	2.42
ISO VG 3	3.2	2.88	3.52
ISO VG 5	4.6	4.14	5.06
ISO VG 7	6.8	6.12	7.46
ISO VG 10	10	9.00	11.0
ISO VG 15	15	13.5	16.5
ISO VG 22	22	19.8	24.2
ISO VG 32	32	29.8	35.2
ISO VG 46	46	41.4	50.6
ISO VG 68	68	61.2	74.8
ISO VG 100	100	90.0	110
ISO VG 150	150	135	165
ISO VG 220	220	198	242
ISO VG 320	320	288	352
ISO VG 460	460	414	506
ISO VG 680	680	612	748
ISO VG 1000	1000	900	1100
ISO VG 1500	1500	1350	1650
ISO VG 2200	2200	1980	2420
ISO VG 3200	3200	2880	3520

(cSt). The viscosity index is a single number representation of the viscosity temperature characteristics of a fluid. Past measures of viscosity using arbitrary scales like Redwood No 1 seconds, Saybolt Universal Seconds (SUS), or degrees Engler should no longer be used. These units have been superseded by the empirical measures previously mentioned; conversion tables do exist but are only true at a fixed temperature.

10. Why do Hydraulic Systems Overheat?

Heating of hydraulic fluid in operation is caused by inefficiencies. Inefficiencies result in losses of input power, which are converted to heat. A hydraulic system's heat load is equal to the total power lost (PL) through inefficiencies and can be expressed as:

$$\text{PL total} = \text{PL pump} + \text{PL valves} + \text{PL plumbing} + \text{PL actuators}$$

If the total input power lost to heat is greater than the heat dissipated, the hydraulic system will eventually overheat. Installed cooling capacity typically ranges between 25 and 40 percent of input power, depending on the type of hydraulic system.

10.1 Beat the Heat

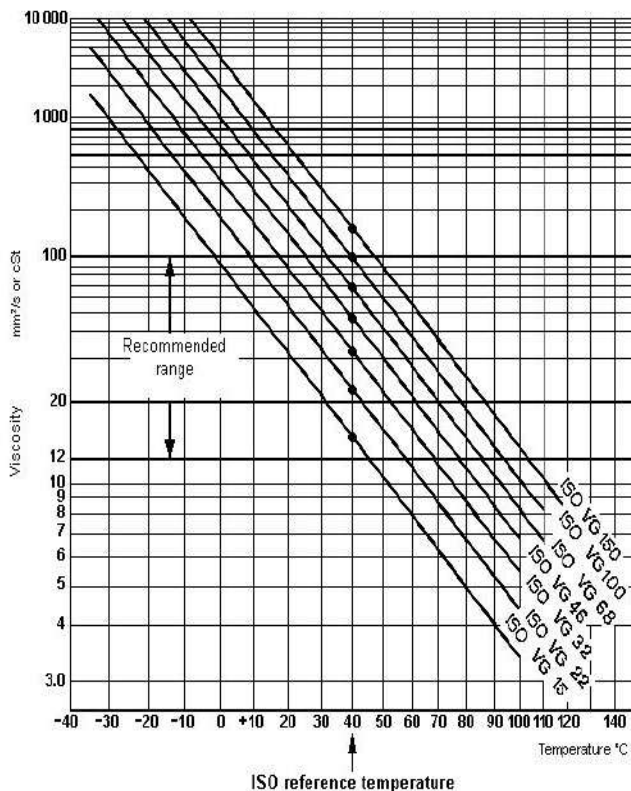
There are two ways to solve overheating problems in hydraulic systems:

Decrease heat load

or

Increase heat dissipation.

Hydraulic systems dissipate heat through the reservoir. Therefore, check the reservoir fluid level and if low, fill to the



correct level. Check that there are no obstructions to airflow around the reservoir, such as a buildup of dirt or debris.

Inspect the heat exchanger and ensure that the core is not blocked. The ability of the heat exchanger to dissipate heat is dependent on the flow-rate and temperature of both the hydraulic fluid and the cooling air or water circulating through the exchanger. Check the performance of all cooling circuit components and replace as necessary.

An infrared thermometer can be used to check the performance of a heat exchanger, provided the design flow-rate of hydraulic fluid through the exchanger is known. To do this, measure the temperature of the oil entering and exiting the exchanger and substitute the values in the following formula:

$$\text{Heat Dissipation (KW)} = \frac{\text{Flow (LPM)} * \Delta T (^{\circ}\text{C})}{34.5}$$

where: KW = heat dissipation of exchanger in kilowatts

L/min = oil flow through the exchanger in liters per minute

$\Delta T^{\circ}\text{C}$ = inlet oil temperature minus outlet oil temperature in Celsius

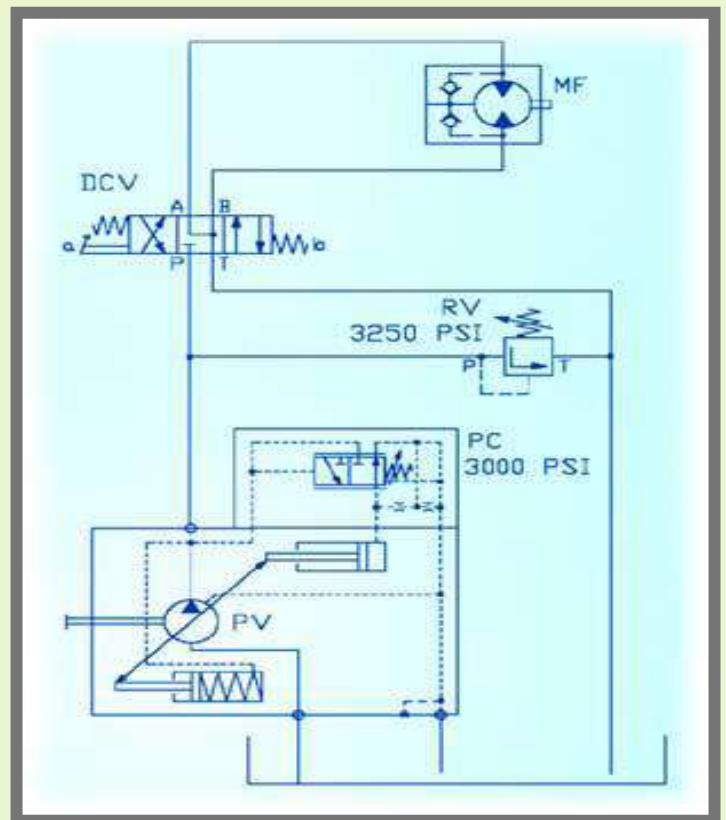
For example, if the measured temperature drops across the exchanger is 4°C and the design oil flow-rate is 90 L/min, the exchanger is dissipating 10 kW of heat. Relating this to a system with a continuous input power of 100 kW, the exchanger is dissipating 10 percent of input power. If the system is overheating, it means that either there is a problem in the

cooling circuit or the capacity of the exchanger is insufficient for the ambient operating conditions.

On the other hand, if the measured temperature drops across the exchanger is 10°C and the design oil flow-rate is 90 L/min, the exchanger is dissipating 26 kW of heat. Relating this to a system with a continuous input power of 100 kW, the exchanger is dissipating 26 percent of input power. If the system is overheating, this means that the efficiency of the system has fallen below 74 percent.

10.2 Pressure Drop Means Heat

Where there is a pressure drop, heat is generated. This means that any component in the system that has abnormal, internal leakage will increase the heat load on the system and can cause the system to overheat. This could be anything from a cylinder that is leaking high-pressure fluid past its piston seal, to



an incorrectly adjusted relief valve. Identify and change-out any heat-generating components.

A common cause of heat generation in closed center circuits is the setting of relief valves below, or too close to, the pressure setting of the variable-displacement pump's pressure compensator. This prevents system pressure from reaching the setting of the pressure compensator. Instead of pump displacement reducing to zero, the pump continues to produce flow, which passes over the relief valve, generating heat. To prevent this problem in closed center circuits, the pressure setting of the relief valve(s) should be 250 PSI above the pressure setting of the pump's pressure compensator.

Closed center circuit showing relief valve (RV) setting 250PSI above the pressure compensator (PC) setting of the variable pump (PV)

11. Cause of overheating

Hydraulic systems can overheat easily. Systems that experience frequent and sustained overheating issues will eventually fail, however, so it's important to watch out for that. Here are some of the common causes of overheating in hydraulic systems and what you can do about them. Where there is a pressure drop, heat is generated. This means that any component in the system that has abnormal, internal leakage will increase the heat load on the system and can cause the system to overheat. This could be anything from a cylinder that is leaking high-pressure fluid past its piston seal, to an incorrectly adjusted relief valve. Identify and change-out any heat-generating components.

A common cause of heat generation in closed center circuits is the setting of relief valves below, or too close to, the pressure setting of the variable-displacement pump's pressure compensator. This prevents system pressure from reaching the setting of the pressure compensator. Instead of pump displacement reducing to zero, the pump continues to produce flow, which passes over the relief valve, generating heat. There are several aspects involved for main cause:

I. Slippage in pumps

Due to internal wear in pumps, the internal leakage or "slippage" increases. On fixed displacement pumps this leakage flows from the high-pressure outlet back through the pump to the low-pressure inlet. In a pressure compensated pump this flow is forced out through the case drain. As this occurs fluid is taken from a high pressure to a low pressure without doing any mechanical work thereby creating heat.

II. Internal leakage in valves

As valves wear occurs, they develop leakage paths that allow high-pressure oil to leak to a low-pressure port creating heat. Improper unloading is the root cause of overheating.

III. Gas-filled accumulators

Pulsating accumulators may develop high pressures on the gas side. This heat can transmit back into the oil raising the temperature and creating a hot spot in hydraulic system. We should check various maintenance aspects of accumulators.

IV. Non-regenerative release of potential energy

When a load is lifted hydraulically, potential energy is stored in the load. Release of the load usually involves non-regenerative throttling, which generates heat.

- V. Improper air flow to oil cooler.
- VI. Leakage and malfunctioning of oil cooler.
- VII. The system parts and components are wearing out and need to be replaced.
- VIII. system upgrades or changes not compatible with the hydraulic circuit.
- IX. The system pressure drop increases unexpectedly.
- X. The hydraulic fluid is contaminated.

12. Conclusion with recommendations for reduction in overheating

Overheating is the second most common issue in hydraulic systems, after leaks. It occurs when the system isn't efficient, leading to power loss converted into heat. To keep the fluid temperature stable, the system needs to remove heat more effectively than it generates. We can prevent overheating by reducing the heat load on the hydraulic oil or improving heat dissipation. If your hydraulic oil exceeds 82°C, it can damage your system and degrade the oil faster. Preventing overheating is vital. It is a common issue in hydraulic systems, so keeping the oil cool is key to avoiding costly repairs and downtime. Following points are suggested to prevent system overheating

- Unload the pump during intervals when pressure is not required. Unloading of vane pumps should function properly.
- Tank should be cleaned religiously at defined interval in schedule maintenance. (every 1000 hrs.)
- Safety valve should work properly.
- Breather of tank should be checked for smooth venting to minimize the overheating if any. (clean every 200 hrs.)

➤ Proper use of oil cooler into the system will help remove excess heat. Exterior of oil cooler should be free of any dirt deposits. Attend any leakage/ seepage of hydraulic oil from oil cooler to prevent deposit of dust on fins). Should be checked daily.

➤ Leakage from oil cooler should also be checked regularly. Oil coolers are used to remove the excess heat in a hydraulic system.

➤ There are many more aspects of thermal characteristics within a hydraulic system than mentioned above. With this information, we should be able to make educated decisions when working with an existing system in order to combat heat generation.

➤ For checking the efficiency of oil cooler check the inlet and outlet ports by touching with hands. There should be difference in temperature of about 8 Degree. If temperature over outlet port is on lower side, it indicates cooler is functioning. (this may be checked in every 1000 hrs. schedule)

➤ During assembly/ maintenance arrow mark should be checked it should be towards outlet port side. Reverse arrow will reduce the efficiency of cooling system.

➤ RPM of cooler fan should also be checked by non-contact tachometer. RPM should not be less than 1700. If it less, adjust the pressure of the cooling system. (this may be checked in every 1000 hrs.)

➤ Rubber mounting of cooler should be checked at regular interval of 100 Hrs. for arresting the vibration if any. If oil is leaking and getting spillage over mounting, the same can damage the rubber mountings and will lead to development of unwanted vibrations.

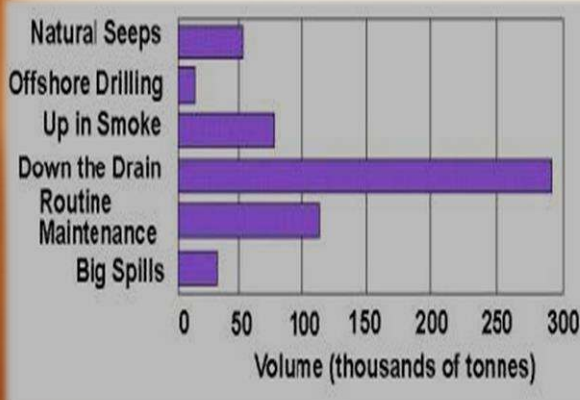
- Keep watch on indicator of Return filter as clogged filter will restrict the oil flow and in turn hose may get brusted or excessive back pressure will be created.
- Unloading of hydraulic system is to be checked. If unloading valve is not functioning properly, temperature of oil will increase and system pressure will be affected adversely.
- Accumulator should also work at desired pressure without and pressure drop for proper function of unloader valve. This is one of the main reasons for smooth unloading of hydraulic system as well as increased hydraulic oil temperature. (rated pressure for each accumulator is mentioned on the accumulator itself)
- Direction of Airflow should also be observed during maintenance. Objective of cooling system is that fresh air should act

over the radiator and oil cooler for smooth functioning.

- Bypass valve functioning of return filter, pressure filter should also be checked at regular interval (Every 100 Hrs.) to avoid loading on hydraulic System.
- Hydraulic systems dissipate heat through the reservoir. Therefore, check the reservoir fluid level and if low, fill to the correct level. (daily)
- The flow of oil through oil cooler should be unrestricted.
- Heat dissipation mainly happens in the hydraulic reservoir. Check its fluid level and ensure it is right. If it is low, top it up to the recommended level. Also, check for any obstructions, like dirt or debris, that might block airflow into the reservoir.



SOURCES OF OIL POLLUTION



In the diagram, “down the drain” includes several domestic, municipal, and industrial sources of oil pollution. Any oil that is spilled in industrial or domestic operations can be washed down storm drains; this includes spills in fuel depots, oil leaks in vehicles and lawnmowers, and non-accidental pouring of paint or oil down storm drains. Runoff carries a great deal of oil into water sources. It is estimated that a city of fifty lakh people will, through pavement runoff, discharge the same amount of oil into waters as a large oil tanker spill would. Five liter of oil can contaminate approximately 38 lakh liters of freshwater!

Glimpses of Recent Events at IRTMTC

Seminar on Cummins Engines



Seminar on Hydraulics



IRTMTC in news

पखवाड़े के अंतर्गत सेमिनार



भारत संवाद
उत्तर मध्य रेलवे के द्वारा भारत सरकार की योजना के
अंतर्गत कार्यक्रमों का आयोजन 01
से 15 अक्टूबर - 2024 तक किया जा रहा है।
प्रत्येक दिन विभिन्न कार्यक्रमों का आयोजन
होगा। इसी क्रम में, उत्तर मध्य रेलवे में दिनांक
01 अक्टूबर को IRTMTC प्रचारार्थ एक सेमिनार
आयोजित किया गया। कार्यक्रम पर आयोजित इस सेमिनार
में मुख्य अतिथि MD/CH प्रचारार्थ
को लेकर BP, Diabetes, Cholesterol, B
का कई अन्य स्वास्थ्य से संबंधित महत्वपूर्ण क
थों (सेमिनार के दौरान प्रश्नों के सही उत्तर देने का
कार्ड के तहत प्रतियोगिता प्रारंभ होगी।
सेमिनार के समापन पर प्रमुख द्वारा
उत्तर भी दिए गए। श्री ललित कटन (I
प्रचारार्थ से छुटकारा पाने हेतु कई वि
कार्यक्रम में मुख्यालय से श्री शिवा
तथा प्रचारार्थ IRTMTC और
संबंधित हैं।

SEMINARS AND MEETINGS



Hindi Pakhwada



Teachers' Day



Medical awareness programme

Glimpses of Recent Events at IRTMTC

Sports Event by Trainees



Plantation Drive under Swacchata Pakhwada By DRM/PRYJ/NCR



Plantation Drive under Swacchata Pakhwada By Principal/IRTMTC



SPORTS AND CULTURAL



Vishwakarma Pooja



Chintan Manan Shivir



Morning Yoga Sessions

Recent Improvements in IRTMTC Campus

Clockwise from Top Left:

1. Display banner boards in lawns
2. Selfie Point for Trainees
3. Road Sign boards in campus
4. Open gym in hostel area



1



Clockwise from Top Left:

1. IRTMTC glow sign board
2. Tea point for trainees
3. Fountain in Lawn
4. Aquarium at entrance



2



[illegible]

An Overview Of Track Machine Organization

SUMMARY OF TRACK MACHINES ON ZONAL RAILWAYS AS ON 01.01.25

MC Type	CR	ECOR	ECR	ER	NCR	NER	NFR	NR	NWR	SCR	SECR	SER	SR	SWR	WCR	WR	Kol. Met	TOTAL
HOT-S-3X	4	4	5	4	5	4	5	8	4	7	3	4	6	4	4	7	0	78
HOT-3X	2	1	1	1	1	0	1	2	1	2	1	1	1	0	2	1	0	18
CSM	7	2	4	3	6	2	3	6	3	8	3	5	6	3	3	5	0	69
WST	12	7	9	9	8	5	9	12	8	12	7	9	10	8	9	10	0	144
UNI	12	8	10	9	10	6	7	14	6	13	7	8	10	6	9	12	0	147
MPT	20	12	12	13	14	9	17	23	13	19	10	14	18	11	12	15	0	232
BCM	14	8	12	10	13	7	10	17	11	15	8	10	12	7	11	12	0	177
HOBCM	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	4
SBCM	7	5	5	5	6	4	4	9	5	9	3	4	7	4	4	7	0	88
PQRS set	0	5	3	6	4	2	5	3	3	8	5	5	3	4	2	4	0	62
T 28	2	2	3	2	2	2	2	3	2	4	2	4	4	2	2	2	0	40
TRT	3	1	2	0	0	0	0	3	0	1	1	1	2	1	1	2	0	18
DTS	8	5	7	7	10	4	4	12	6	12	6	7	8	4	9	9	0	118
BRM	7	5	4	6	7	2	4	6	3	9	4	6	6	5	5	8	0	87
UTV	17	8	15	11	14	6	12	17	10	19	10	9	15	11	11	18	0	203
RGM	1	1	1	1	1	0	0	1	0	1	0	1	1	1	1	1	0	12
SRGM	0	1	1	0	1	0	0	1	0	1	0	1	0	1	1	0	0	8
RIV	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
RBMV	4	0	2	1	7	0	0	1	0	0	3	0	0	1	1	0	0	20
RTH	1	0	1		1	0	0	1	0	1	0	0	0	0	0	0	0	5
MDU	10	6	10	10	10	10	10	15	5	10	10	5	10	5	10	10	0	146
MBIU	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	2
RMV	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	11
RMM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8 Stone RGM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
TOTAL	131	82	109	98	120	63	94	154	80	152	83	95	120	89	97	125	1	1693
SBCM from DFCCIL for 2 year	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
RBMV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4
G.Total	131	82	109	98	120	63	94	155	80	152	83	95	120	89	97	129	1	1698

An Overview Of Track Machine Organization

Overview of Staff Strength for Available Track Machines as on 01.01.2025

Rly	Category of staff	No. of Existing/Available Machines	Staff Required	Posts Sanctioned	Staff on Roll (Departmental)	Vacancy compared to Sanctioned Posts	Staff on Roll (Outsourced)
CR	Total	128	1838	1643	1468	175	145
ECoR	Total	82	1645	1497	789	708	64
ECR	Total	108	2044	1955	853	1102	0
ER	Total	100	1711	1063	780	283	6
NCR	Total	120	2055	1624	1347	277	0
NER	Total	63	1130	602	481	121	40
NFR	Total	91	1665	852	637	215	254
NR	Total	154	2366	1942	1660	282	25
NWR	Total	80	1391	1114	785	329	67
SCR	Total	164	2989	1514	1106	408	421
SECR	Total	84	1284	939	867	72	58
SER	Total	93	1605	981	864	117	0
SR	Total	120	2445	1721	1548	173	0
SWR	Total	85	2448	1236	1058	178	68
WCR	Total	97	1768	1613	1098	515	49
WR	Total	137	2031	1613	1251	362	97
IR	Total	1706	30415	21909	16592	5317	1294

Category-wise Break-up of Staff Strength for Available Track Machines as on 01.01.2025

Rly	Category of staff	No. of Existing/Available Machines	Staff Required	Posts Sanctioned	Staff on Roll (Departmental)	Vacancy compared to Sanctioned Posts	Staff on Roll (Outsourced)
IR	SSE	1706	5239	3987	2773	1214	38
	JE		2583	2414	1889	525	41
	Track Mc Maintainer		9574	7487	5958	1529	212
	Machine Assistant		10725	7684	5804	1880	588
	Cook		1766	64	20	44	415
	Others		528	273	148	125	0
	Total		30415	21909	16592	5317	1294

Recent Improvements in Facilities at IRTMTC



Compactors in Library



Display of Digital Timetable



Display of components in Lab



Repeater Screen in Classroom



Computer Lab with Touch Panel



All Labs with interactive Touch Panel



New classroom with Touch panel



Newly developed Female staff restroom

SPS Diagnosis System

-By
Rajesh Dwivedi
Instructor/IRTMTTC

1. General

Modern railway track maintenance relies on precision and reliability, both in track alignment and the performance of maintenance machinery. New tamping machines by Plasser& Theurer, are continually innovated to enhance the operational efficiency and serviceability. Among its advanced systems, the **SPS Diagnosis System** stands out as a transformative technology for machine diagnostics and maintenance.

It is directly related with Programmer unit or PLC of the machine. And hence, it is very important to have a clear understanding of PLC and logic chart.

2. What is PLC?

PLC stands for Programmable Logic Control. It acts as controller of the machine and hence, in simple worlds we can treat it as '**Brain of Machines.**' It means every operation of machine is controlled through logic which is programmed by OEM on user's (IR) requirement.

It ensures following in tamping machines:

- a.** Ensures safe operation by not generating any output if one or more logics are incorrect.
- b.** Ensures proper sequencing of machine operation by operators,
- c.** Helps in fault finding and diagnosis of any operation of machine using logic assigned and,

- d.** Helps in reducing time taken to troubleshoot any fault by use of various indications.



Fig:SPS-01-Complete view of Programmer unit

PLC is a micro-processor-based controller and has a memory (EPROM-Erasable Programmable Read Only Memory) in IC (Integrated Circuits) form where the programme of the machine is stored and is accessed by micro-processor logically. Figure: SPS-01 shows the complete view of Programmer unit in machines and Figure: SPS-02 shows various hardware of PLC.

To assist the operators regarding the logic of various operations of any machine,

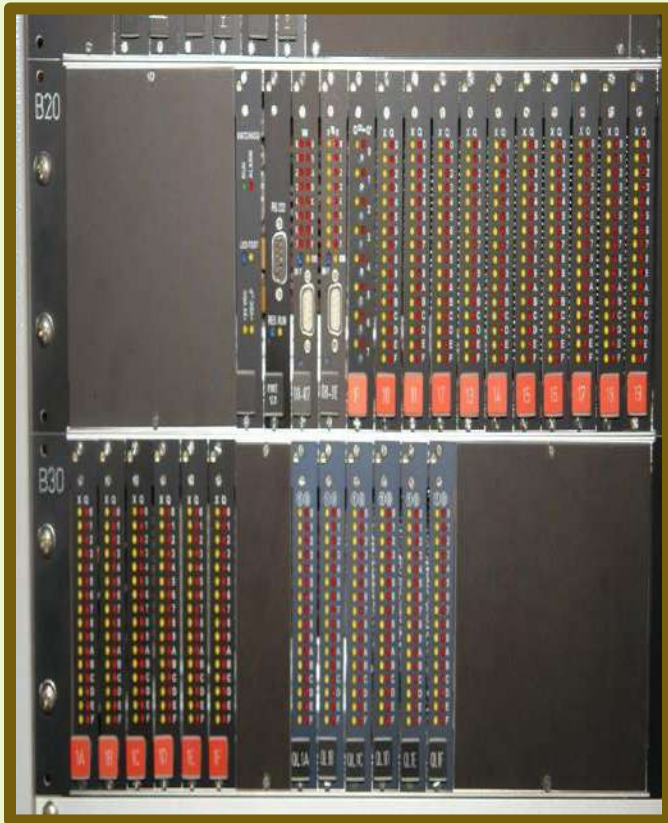


Fig: SPS-02-Hardwares of PLC

the users (operators) are provided with Logic Charts which are discussed in the next section.

3. What is Logic Chart?

Logic charts are physical charts which are provided by OEM to assist our operators regarding the logical conditions of various machine operation. The programme of logic chart is based on three types of logical operations as discussed briefly below:

a. AND operation: It represents mandatory functions. That means, if two inputs are connected using AND operation, then it is mandatory to obtain TRUE/HIGH/ON value of each input for final output to be TRUE/HIGH/ON. In other words, output will be TRUE/HIGH/ON, only when all inputs are

TRUE/HIGH/ON. It is represented in our Logic Charts using ‘^’ symbol.

b. OR operation: It represents optional functions. That means, if two inputs are connected using OR operation, then it is optional to obtain TRUE/HIGH/ON value of each input for final output to be TRUE/HIGH/ON. In other words, even if any one of my inputs is TRUE/HIGH/ON, output will be high. It is represented in our Logic Charts using ‘v’ symbol.

c. NOT operation: It represents restricted functions. That means; to get TRUE/HIGH/ON output, my input should be FALSE/LOW/OFF. In other words, it acts as the inverter. It is represented in our Logic Charts using ‘-’ (bar) over the input function.

In tamping machines, the logic charts mainly have two sections:

a. Input section: This contains all the inputs to the PLC through various sources like switches i.e. manual operated switches, limit switch, proximity sensor switch, temperature switch, pressure switch etc. Inputs are denoted by ‘X’ in logiccharts. In a single input-output PCB (X-Q PCB) there are 16 input signals.

	tamping syst. on	2X 1 9		rear lev. pick-up in upper pos(V31)	1X 4 9
	penetration assist off	2X 1 A		COMP. L.H. LOCKED FRONT	X 4 A
	satellite in front of middle pos.	2X 1 B		COMP. R.H. LOCKED FRONT	X 4 B
	satellite front pos.	2X 1 C		left clamps u. lift or stop	2X 4 C
	only left tamp.u. (impuls)	5IX 1 D		right clamps u. lift or stop	2X 4 D
	only right tamp.u. (impuls)	5IX 1 E		bogie tension to left	2X 4 E
	delayed output Q1F	X 1 F		bogie tension to right	2X 4 F
	lining & lev. start by units-down	2X 2 0		front jointflaps open or close	5IX 5 0
	2. sign. satell. front pos.	1X 2 1		rear jointflaps open or close	5IX 5 1
	satellite rear pos.	1X 2 2		satell. l/r movem. auto mode on	2X 5 2
	reverse drive	5IX 2 3		satell. man. contr. to left	2X 5 3

Fig: SPS-03- Input section of logic chart

Figure: SPS-03 shows a sample Input section in logic charts of CSM machine.

b. Output section: This contains all the outputs of PLC. There are four outputs generated by PLC which are discussed briefly below:

i. Q (Main command from PLC):

This command is used to operate smaller loads like LED, diode, transistors, relays etc. and cannot operate the higher loads like solenoids of DC valve etc. In a single input-output PCB (X-Q PCB) there are 16 output commands.

ii. QL (Load relay output/Power output): This command is used to operate the higher loads like solenoids of DC valves etc and is controlled by main output command of PLC i.e. Q. In a single QL PCB, there are 16 commands. Refer Figure: SPS-04 for sample Q & QL outputs of logic chart.

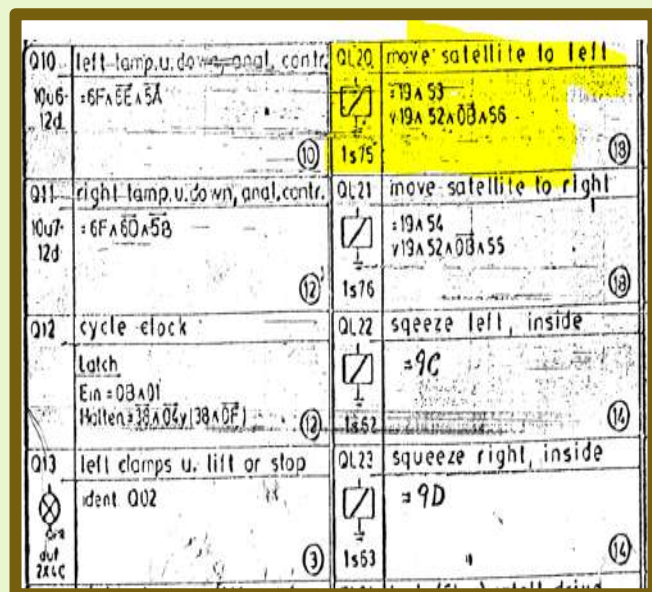


Fig: SPS-04- Q & QL outputs of Logic chart

iii. Q' (Time delay output): This command is used to introduce a certain amount of time delay (0.2 Sec- 3.5 Sec) to the specific operations wherever required.

In a single Q' PCB, there are 08 commands. Refer Figure: SPS-05 for time delay output section of logic chart.

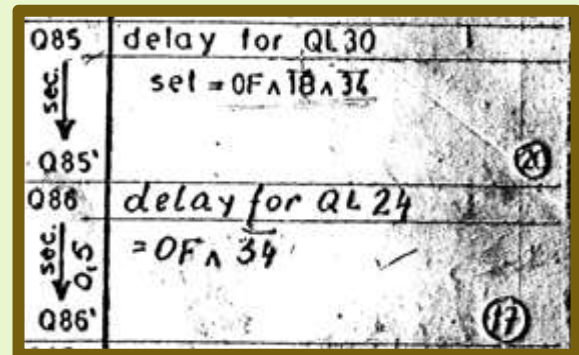


Fig: SPS-05- Time delay outputs

iv. Q→X (Subroutine output): This command is used where some sub-programs are repeatedly used in the main program. The operations which are frequently used are controlled by sub-routine commands of PLC. In a single sub-routine PCB, there are 16/32 commands. A sample section of sub-routine outputs in logic chart is shown in Figure: SPS-06

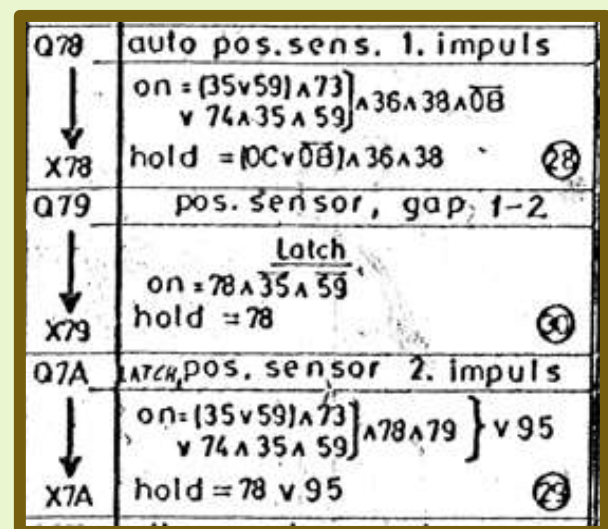


Fig: SPS-06-Sub routine outputs

4. Example of logic chart:

Various sections of Logic chart of CSM machine are already discussed above. Let us take an example of satellite movement towards Left side. As seen in

logic chart, the command for this operation is QL20. It means this function is controlled by QL command. There will be multiple numbers of QL PCB in the machine. But for this operation, as the command is QL20, we must look in QL2 PCB at LED no. 0 as shown in fig . Normally, when the command is not available, then the corresponding RED LED of QL2 PCB will be glowing. When this command is generated, yellow LED will glow.

The condition in logic chart is [QL20=19^53]. This means that the command QL20 is dependent upon two inputs X19 & X53 and both are mandatory inputs as they are connected by '^' symbol. Upon referring the logic chart, we can see that X19 is for tamping system on coming from switch for tamping system on. Also, it can be seen from logic chart that X53 is for satellite manual control to left and this input will be available to PLC when the

operator makes the desired selection using the push button.

For QL20 command to be ON, yellow LED no. 0 of QL2 PCB should glow and this will be possible when both X19 (Yellow LED no. 9 of I/O PCB-1) & X53 (Yellow LED no. 3 of I/O PCB-2) are present.

5. What is SPS Diagnosis system?

The **SPS Diagnosis System** is an integrated monitoring and diagnostic solution embedded within Plasser& Theurer machines. In simpler words, SPS is a diagnosis tool where the Logic Chart is available in digital form. "SPS" stands for **Steuerungs Programmierte Steuerung**, German for "Programmable Logic Control," which is at the core of the system. This advanced technology continuously monitors the machine's systems and subsystems, diagnosing issues in real-time and providing actionable insights for operators.

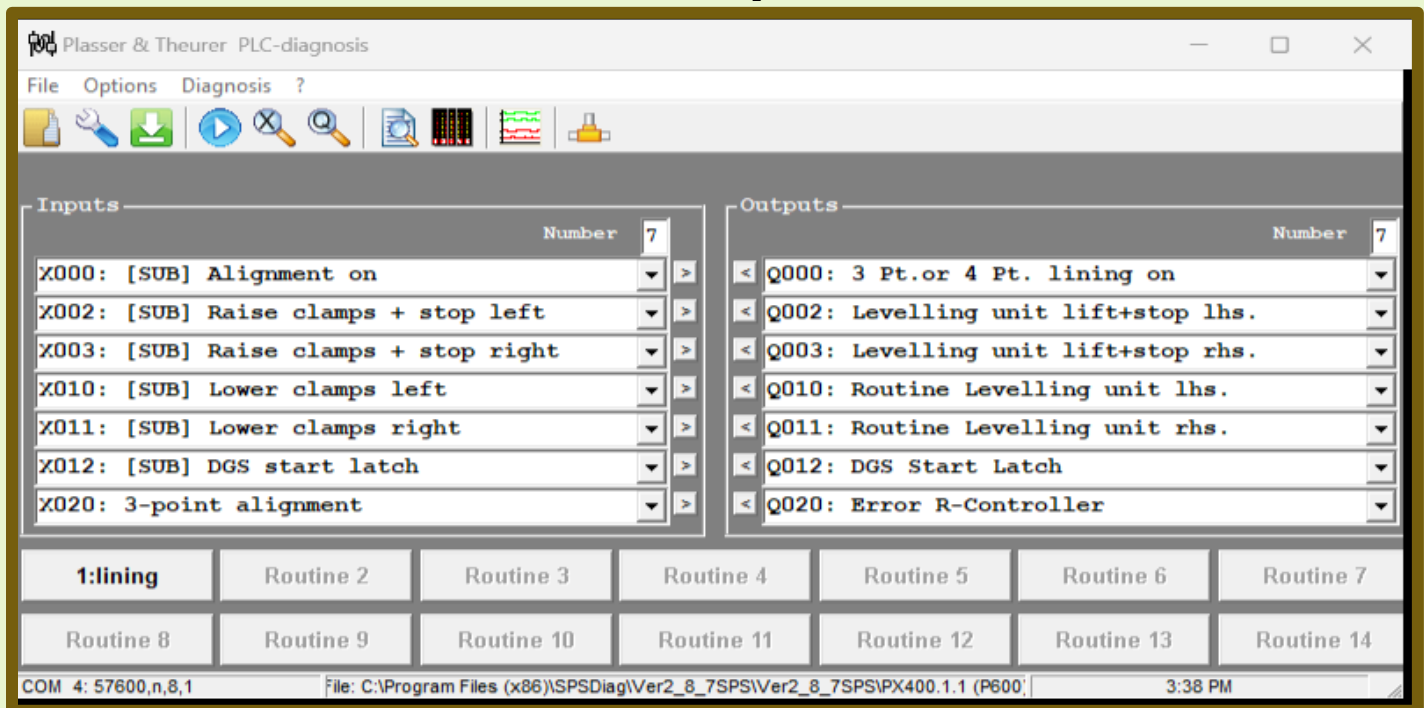


Fig: SPS-07- Home screen of SPS Diagnosis software

Thus, by integrating this digitalized diagnosis system in our tamping machines, we can save our quality fault finding time during block. Earlier system of fault finding with the help of logic charts was time consuming and required technical skill for fault tracing. While SPS diagnosis system is user friendly and easy to use.

6. Reading logic chart using SPS diagnosis

SPS diagnosis is a software tool which is available in the ALC computer installed in front cabin. To access this, simply turn on the computer and search for SPS Diagnosis software icon as . Double click on the icon to run the software and click OK to start communication with PLC.

As you can see in Figure: SPS-07, there are again two sections for fault finding in the main window. They are namely:

a. Input section: This library contains all the inputs used in that machine. It is represented by X and is available in left side of the screen as shown below. Maximum 7 input scan be viewed at once in the diagnosis screen (1-7).

b. Output section: This library contains all the outputs of PLC. It is represented by Q and is available in the right side of the screen as shown below. Maximum 7 outputs can be viewed at once in the diagnosis screen (1-7).

The stepwise procedure for using SPS diagnosis tool is discussed in the next section.

7. Stepwise Procedure for SPS diagnosis:

Generally, during fault finding, we are required to search outputs from PLC. Following steps discuss the same:

a. Click on search Q  option from the quick menu bar in top of the screen as shown.

b. A new dialog box will pop-up as shown in Figure: SPS-08. Write the search keyword related to that function. Example keywords can be like 'lifting', 'lining', 'driving', 'squeezing' etc. Keep in mind that the more accurate the search word will be, the faster the fault can be traced.



Fig: SPS-08- Search box for X and Q

c. Keep on searching the same keyword using forward arrow in the search box until you find the desired output command. Alternatively, you can refer the logic chart to find this output command of the function you are searching.

d. Click ok to load the same output command in the output command box at required place (1-7)

e. You can load maximum 7 output command as per your need to view multiple

outputs in a single diagnosis screen for better and quick fault finding.

f. Now go to menu bar and click on 'Diagnosis' option. A new dialog box will open showing all the selected output commands with their logic conditions as they are available in your physical copy of logic charts.

g. Click on 'start' to view the real time status of various output commands selected by you and the various inputs and sub-routines available in their logic condition. You will observe that these are visible in various colours. Also see that at the bottom of this diagnosis screen, there will be an index showing colour scheme for various conditions of inputs and outputs. Sample diagnosis screen is shown below (Figure: SPS-09)

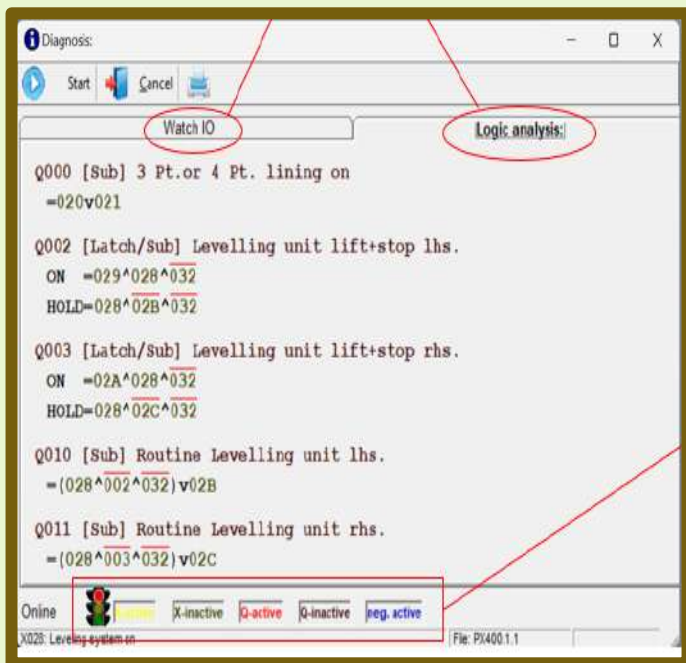


Fig: SPS-09- Diagnosis screen of SPS showing logic chart in digitalised form

h. The colour of these inputs and outputs will keep on changing based on their status (active or inactive). Normally active inputs & outputs are shown in green colour and

inactive input & outputs are shown in red colour. You can additionally change the colour scheme using settings option in the SPS diagnosis software.

i. Logically check all the conditions of the desired output. If any condition or input seems failed or missing, then attend that particular input to correct the logic.

j. Also there is a feature in diagnosis screen that it shows you the details about any input or output when you hover the mouse over that command for a second.

k. Using this feature, you can also learn about various logics and do mind-mapping when your system is healthy and working properly.

This procedure will be of more use during fault finding and user friendly to you when you practice this for a few commands during healthy condition of the machine. Besides digitalised logic chart, SPS diagnosis has some additional features which are discussed in next section.

8. Additional features of SPS diagnosis software:

There are following additional features in the SPS diagnosis software:

a. Board View: There are various PCBs used in PLC for input and output commands. These PCBs are located physically in various panels located at different places in our machine. Board view enables us to view the simulated version of all these PCBs (maximum 16 at a time) in a single screen with real time status of various LEDs associated with input and output commands. Additionally, if you

hover the mouse at these LEDs, it will show brief description about the input or output related to that LED. To view this, there is an option of 'board view' from the top right of quick menu. Then we can make selection of desired PCB using the palette box. (Refer Figure: SPS-10 for sample screenshot.

be recorded in the background during working and later, this recording can be accessed in a new dialog box graphically. A sample of this chart recording is shown below in Figure: SPS-11.

c. Create your own routines: SPS

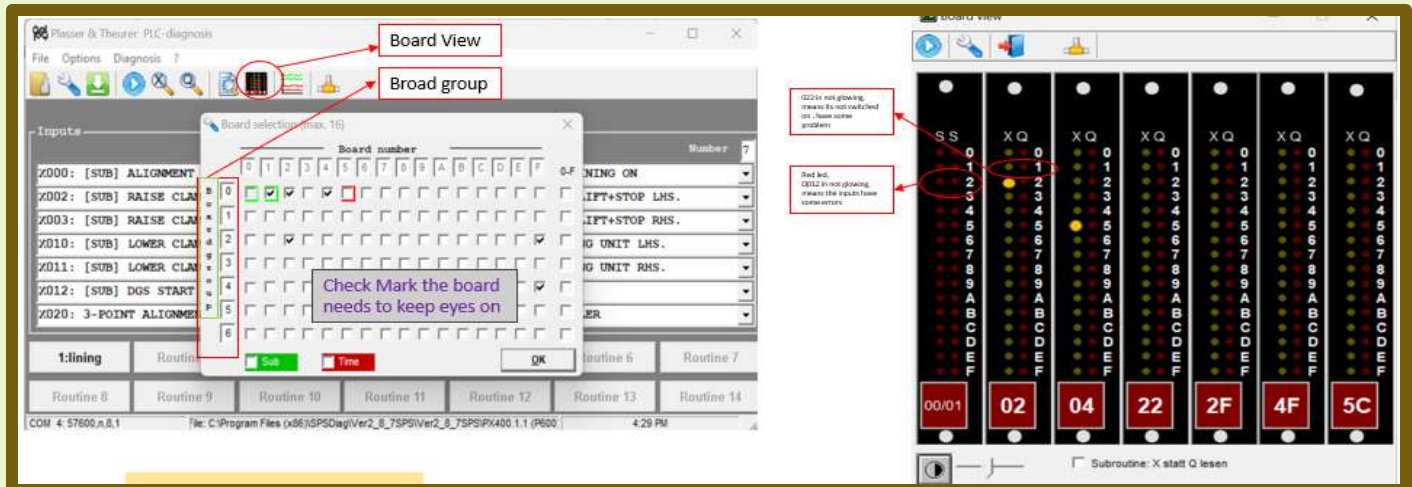


Fig: SPS-10- Board view feature of SPS

b. Chart Recording: In SPS Diagnosis, there is an option to record several inputs and outputs in graphical form. To start recording anytime during machine operation, click the chart recording option. Be careful to mention input and output commands in the input and output boxes in the main screen. The selected X and Q will

Diagnosis system enables user to create a set of inputs and outputs of their own choice and save this set in form of **routines**. Maximum 14 number of customised routines can be stored. It is a very useful feature to store several inputs and outputs related to major important functions like lifting, lining, tamping, squeezing, driving etc for quick referral and to effectively reduce the fault-finding time.



Fig: SPS-11- Chart recording feature

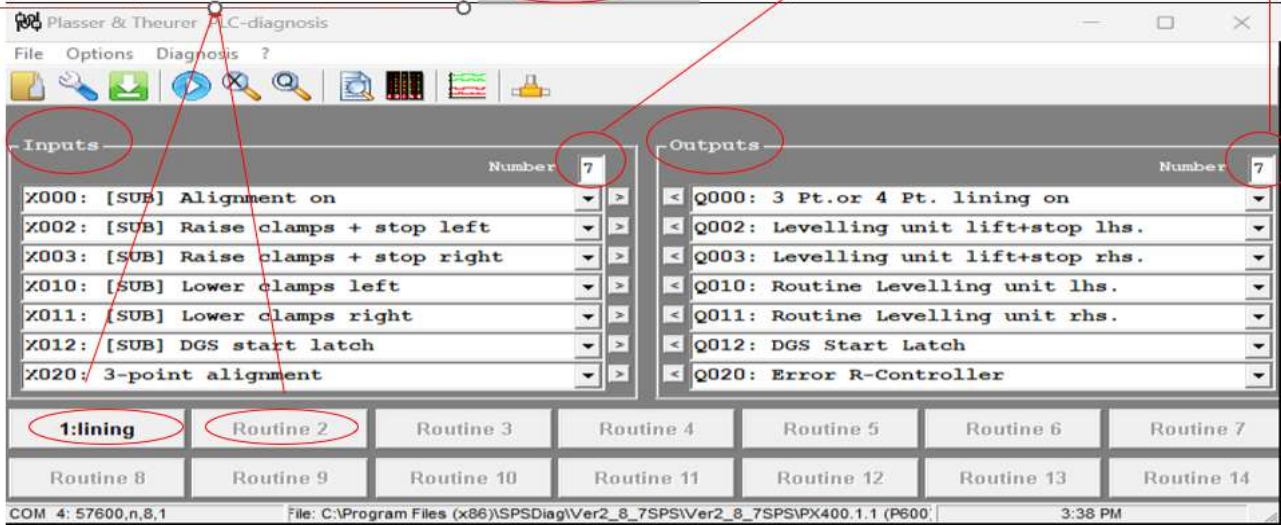


Fig: SPS-12- Creation and storing of routines

9. Conclusion:

As it is evident from the article above that SPS diagnosis system is an alternative for fault finding to the physical logic chart system. Let us now conclude the article by listing the advantages of SPS diagnosis system over conventional logic chart system:

- a. Time saving during occurrence of faults which is golden hour for machine.
- b. User friendly interface and requires very little technical skill.
- c. Chart recording feature enables user to trace the intermittent faults easily which is nearly impossible to trace using logic charts.

- d. Board view feature enables the operator to keep a watch on all the operations of the machine immediately.
- e. Easy to teach and train new operators about the functioning of PLC in machine and its logic by viewing the details of various inputs and outputs simply by placing mouse over them.
- f. Major inputs and outputs of any function can be stored by user in various routines.
- g. For future references, printouts and screenshot images can be taken by user.

The **SPS Diagnosis System** exemplifies contribution of advancing railway track tamping technology in track maintenance. By offering real-time diagnostics with user-friendly interfaces, this system not only enhances the reliability of tamping machines but also

reduces operational costs and downtime. By doing so, it empowers our operators in better understanding of machine's programmed logic and thereby assisting them during fault finding. To ensure track machine organization's commitment to

maintain high standards of track geometry and ensure uninterrupted service, the SPS Diagnosis System is an indispensable tool. Its integration into newer machines drives innovation for the future of railway maintenance.



Here's what you need to know about the PLC – a key element in the automated control systems:

1. Used to control devices, the PLC 'softwires' components together by monitoring a series of different inputs and manipulating the output for the desired control/effect.
2. It contains a programmable (changeable) memory in which a sequence of instructions is stored. Those instructions enable the PLC to perform various useful control functions like relay logic, counting, timing, sequencing, and arithmetic computation.
3. Its key advantage is that it is highly flexible in how it can be programmed while still being reliable – meaning no program crashes or mechanical failures (as is the case with some traditional control systems).
4. PLCs come in many shapes and sizes. They can be small enough to fit in your shirt pocket while more involved controls systems require large PLC racks.
5. Modern day PLCs are programmed with specialised software. A common form of programming is Ladder Logic and involves the use of symbols rather than words.
6. A single PLC can be programmed to replace thousands of relays and timers with one programme.
7. It can be designed to run its one program at a very fast speed, responding very quickly to any of the events under its control. For example, controlling a machine's production running at 30 000 units an hour!

Mechanized Track Maintenance: A foresight on future need of semi high speed routes over Indian Railways

**-By
Sanjay Asthana
Principal/IRTMTTC**

1. General

On high-capacity Railway lines, especially when high axle loads are under operation over Indian Railways, it is very important to use appropriate track maintenance and upgrading procedures, in order to enable their optimal and efficient use. By this, also a low level of dynamic wheel/rail forces can be maintained, which minimizes strain on both track and rolling stock. Track maintenance technologies are being developed continuously, in order to meet the high demands of heavy-haul railway track. Today's machines for track construction and maintenance achieve a far higher output than ever before, and also an increasing number of intelligent control circuits is being adopted. This has a decisive effect on the cost-effective performance of the tasks and the work result achieved. The focus is very much on the long-term effect of a maintenance operation, as well as cost optimization - investment in high-tech machines with state-of-the-art work units for maintenance of heavy-haul railway track is worthwhile. We should think and envisage the high output Track machines with capability of rectifying the long chord errors and effective retentively as per growing dependency of Indian Railways for mechanized maintenance of semi high speed Track in our country. This article is

attributed as a foresight for future Track machines we may adopt in our country,

Track maintenance machines have normally very long service lives above stipulated codal life as per RDSO. More than 50% of the machines commissioned in the last 70 years are still operating worldwide and, in our country, CSM and UNIMAT machine of nineties are still working after nearly 35 years. This means a typical track maintenance machine is in service for several decades. In a cost analysis over a long service life, the importance of life cycle costs, which are mostly made up of operating costs, becomes greater. In many cases, decisions to procure a track maintenance machine were mostly based on its purchase price. All other costs which arose over the product life cycle played less of a role.

To make pace with global advancement, modern Track Machines are the need instead of continuing with heavy maintenance input on old machines. New machine should be planned energy-efficient, economical, quiet, low-emission, eco-friendly, user-friendly, resource-saving, easy to maintain, fast progress/high output and time-saving to meet out the need of the day. OHE based driven machines may have a significant contribution to this goal and have alternative drives for climate-friendly track maintenance.

2. Use of Electricity instead of fossil

Until now, track maintenance machines in our country have used internal combustion engines for running and working. Diesel engines drive the machines during transfer travel and provide the hydraulic pressure for working at the worksite. This leads to CO₂ emissions, causes noise, and is problematic during construction work in tunnels and in densely populated areas. The alternative green current from the overhead contact line powers electric drives. This applies to the driving of machine and to drive various work units. The use of electric current as an energy source reduces local CO₂ emissions to zero and makes operation significantly more energy-efficient. In Europe a drive for fossil-free machine (one that does not require fossil fuels) is already operative to equip 50% of the machines with alternative drive systems by 2030.

3. Renovation of old machines with new technology

Most of the old machines being renovated with eco-retrofits with electric tamping units in existing fleets in modern countries. They reduce the rotational speed of diesel engines, decreasing fuel consumption in existing fleets. In Construction, overhead contact line cannot be used via the contact wire during working. Batteries may be the alternative option for power supply power for an entire shift and are being charged during transfer travel via the overhead contact line, via recuperation by use of power pack as a backup.

4. Modern E³ (economic, ecologic, ergonomic) Machines:

For track maintenance machines in Europe, E³ hybrid drive was launched in the year 2015. Track Machine in this segment is equipped with a battery to enable them to work an entire shift without emissions, as well as machines that use green traction current from the overhead contact line. For large on-track machines operating with the assembly line method, synthetic fuels are a promising way to reduce the environmental impact and make track maintenance machine operations more sustainable. Synthetic fuels are also an environmentally friendly alternative wherever there is a reliance on a combustion engine if no OHE equipment is available.

5. Bio fuels used as hydro treated vegetable oil

Synfuels include all fuels that are synthetically produced from non-fossil origin. They include hydrogenated vegetable oils, or HVO (hydro treated vegetable oil), e-fuels, and x-to-liquid fuels, e.g. gas-to-liquid. HVO is a second-generation bio fuel and is already used in freight transport. DB Cargo in Germany has saved around 30,000 t of CO₂ tin one year by replacing 10 million litres of diesel fuel with HVO.

6. Prevention of noise pollution

Energy efficiency is significantly increased by switching to electric drives, as the electric propulsion system is much more efficient than an internal combustion engine. Simultaneously, the use of fossil fuels and lubricants is declining noticeably. E³ machines reduce local CO₂ emissions to

zero and reduce noise by up to 20 dB(A). This will lead to greater work safety and comfort for the machine operators. The E³ range covers tamping, ballast distribution and ballast profiling, stabilization of tracks and turnouts as well as overhead contact line construction and maintenance.

7. Some latest modern Machines currently deployed in advance countries

7.1 09-4X E³ Dynamic Tamping Express for Plane Track tamping

As of now, this is the fastest tamping machine for tamping of Plane Track in the world, which is manufactured by m/s Plasser & Theurer. Machine is Powered by a high-performance electric motor by use of the electrical energy from the OHE wire.

This new machine design is incorporated with separate hybrid power wagon to take power from OHE with battery backup. This machine is capable of tamping four sleepers at a time with a progress of 2.4 Km track in per effective hour. Switch between drive systems without interruption as fully automatic control ensures safe changeover. Drive system for travelling and working are

electrical driven. Extended range of applications in urban areas and tunnels is possible. Lifting and lining unit is operative with four roller lifting clamps. This machine is the fastest machine and providing more stable track position due to simultaneous tamping of four sleepers. Integrated dynamic track stabilization system controls initial settlement of the track bed after tamping. PIC is the operative system in this machine. Complete control of the measuring systems is operative with WIN-ALC (automatic guiding computer) in front cab.

7.2 UNIMAT09-8X4/4S Dynamic E³ for Points and Crossing Tamping

The Unimat's universal tamping unit is a unique machine to meet the special requirements of turnout maintenance for increasing speed track. The split-head technology makes it possible to shift each of the four tamping unit segments individually and sideways. If there is an obstacle in the turnout, the 16 tamping tines simply tilt upwards. Provision is available for simultaneous tamping of two sleepers with combination of the 4x4 universal tamping unit with half of a 09-2X plain-line tamping unit. With this feature





machine can tamp turnout as well as approaches in very effective manner. Machine has facility for variable use of 32 tamping tines, 3-rail lifting, and 4-rail tamping. Maximum speed of 100 km/h during self-propelled which enables to save time of traffic during shifting as well for reaching to site in block. Machine and cabs are in state-of-the-art design and in line with ergonomic aspects.

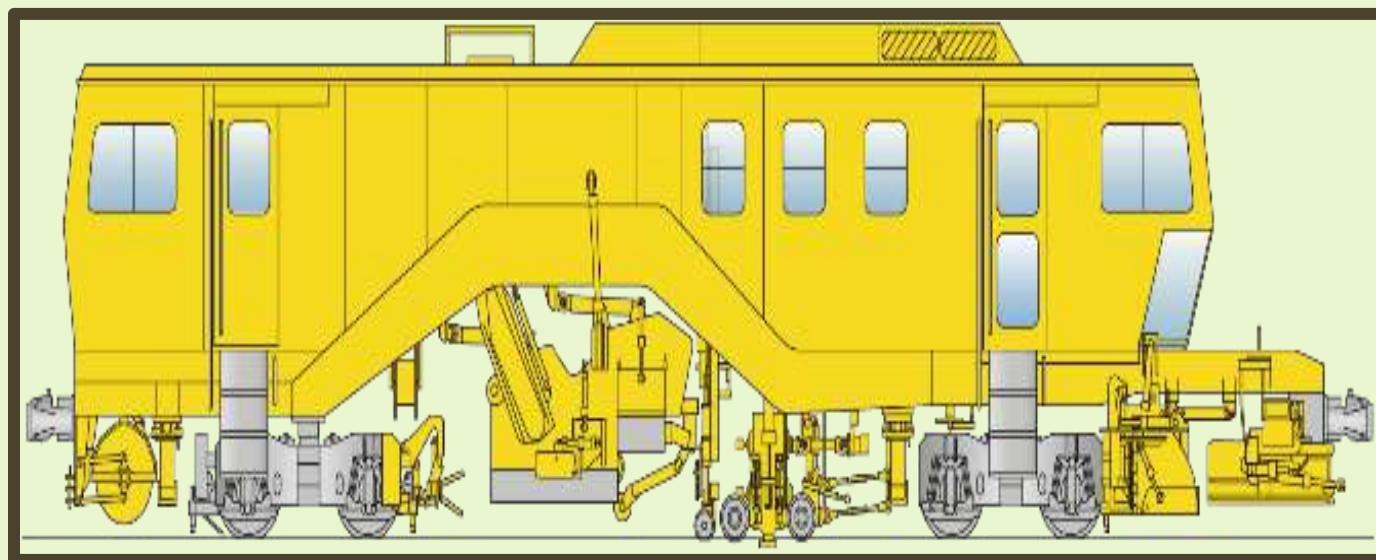
7.3 Ballast Regulator Machine with Stabilization unit

This machine is also essential and future need for Indian railway. Boxing after tamping is extremely essential for retaining the Track parameters. This machine is

combination of BRM and dynamic Track Stabilizer to follow up with tamping work. This will lead to reduction in number of machines and better utilization of both activities by one machine.

7.4 Trailer for Stabilization Machine

Trailer for ballast compaction is again a useful concept to save energy and reduction in number of self-propelled machines running as DTS over Indian Railways i.e. 200 in number. This creates a high-quality and homogeneously compacted ballast bed along with high track geometry durability. Restoration of the required lateral track resistance after tamping is extremely essential and useful





for higher speed Track maintenance. Increase the service life of track infrastructure and reduce life cycle costs.

8. Conclusion

Use of high speed and high output E³ machines are the future need of in Indian Railways as we have achieved around 97% electrification of all routes till December 2024. It is a thought process to make pace with global advancement in complete mechanization of Track maintenance of Indian Railways. The continuous development and improvement of track maintenance machines has led to a series of designs for all applications that not only meet the high demands of heavy haul Railway Track, but also provide cost-effective solutions - by increasing the working speed by implementing technologies that save precious raw material. New high-tech machines contribute to the sustainability of quality of maintenance in heavy haul railway lines. These machines are important, in order to reduce strain on the infrastructure and minimize track possessions for

maintenance activities. Furthermore, digitalization of machines, machine, higher speed, environment friendly design and automation of machine operation will contribute to a further increase in efficiency and safety of mechanized maintenance of heavy-haul Track of Indian Railway. High cost of advanced Track machines limits and restricts to adopt for Indian Railways. But in the same time, we face the challenges related to technological obsolescence. Rapid advancements in technology can render existing machinery outdated, necessitating frequent upgrades and improvements in existing system operative on Track machines. Huge shortage of skilled Engineers in the organization poses a significant challenge for optimum utilization. As the machinery becomes more technologically advanced, the demand for specialized skills increases for effective operation and it is unfortunate that workforce is yet not keeping pace at Par with the advancement in mechanized Track maintenance technology.

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महाकुंभ2025

-By
Anku Adarsh
Chief Instructor/IRTMTTC

गंगा के तट पर उमड़ी है भीड़,
आस्था की लहरों ने खींचा हर पीढ़ ।
हर दिल में उम्मीद का दीप जल रहा,
संगम में संसार का रंग घुल रहा ।

सूरज की किरणें जल पर पड़े झिलमिल,
ध्यान में लीन हैं संत और प्रभु से रहे मिल ।
शंख नाद से गूंजे धरा और गगन,
श्रद्धा की लहरों का साक्षी हर कण ।

चारों ओर मंत्रों की गूंज सुनाई दे,
मन को शांति, आत्मा को हरसाई दे ।
मेला ये नहीं, जीवन की व्याख्या है,
धर्म और संस्कृति का अद्भुत साध्य है ।

महाकुंभ 2025 का ये पर्व महान,
संघर्ष, प्रेम और भक्ति का बयान ।
सदियों से चलती ये परंपरा,
भारत की मिट्टी का है ये दर्पण बड़ा ।



स्नान में विश्वास का है अद्भुत भाव,
हर डुबकी में मिलता नया एक स्वभाव ।
पुण्य की राह पर चलता हर यात्री,
महाकुंभ है सजीव कथा की काव्य-पंक्ति ।

हर किसी को जोड़ने का ये सेतु बने,
विश्व को भारतीय संस्कृति का चेतन बने।
महाकुंभ 2025 का ये अनूठा रंग,
धरती पर स्वर्ग का कराता है संग।

पहला जन्मदिन

-By
Shabnam Banu Nilger
JE/TMC/ZMC/AII/NWR

पहला जन्मदिन कुछ खास सा होता है

यह एक आम दिन है

लेकिन नया अहसास सा होता है

यह स्मृति है

बीते हुए हसीं पलों की

तुम्हारी पहले दिन की

और उन रातों की जिनमे हम जागे हैं

कभी मैं झल्लाती थी

तो कभी तुम्हारे मासूम चेहरे की ओर देखती



उन छोटी छोटी

आखो की तरफ

और नन्ही नन्ही

उँगलियों से तुम जो

मुझे

छूते थे

उन यादों की

जिसमे तुम दिन भर सोते थे और रात भर

जागकर इधर उधर देखते थे

फिर तुम बढ़ने लगे

बैठने लगे

और गिरने लगे

तुमने पहचानना शुरू ही किया था शायद मुझे

कि मेरे जाने का वक़्त आ गया

और मैं यहाँ संगम पार आ गयी

तुम्हारे जो बचपन के शुरूआती दिन थे

उनसे मैं वंचित रह गयी

तुमने फिर चलना सीखा और गुनगुनाना भी सीख लिया

मैं सिर्फ तुम्हे देख ही पाती हूँ

तुम्हे छूना और गोद में भर लेने

की इनायत मिली ही नहीं है मुझे

तुम खुश हो महफूज़ हो

बस इसी बात का सुकून है मुझे

जब तुम्हारा पहला जन्मदिन आने वाला है

मैं मौजूद नहीं हो पाऊँगी वहाँ

मेरे इम्तेहान होंगे

तुम मेरी मशरूफियत समझना

मेरी मोहब्बत तुम से बा-दस्तूर वही रहेगी

तुमसे मिलने की, ढेर

सारा दुलार करने की

मेरी चाह यहीं रहेगी

इन सबमें मेरी ख्वाहिश

अधूरी रह जाएगी

तुम्हारे लिए तमाम



तोहफे होंगे

सब किरदार होंगे

बस मैं यहाँ इस अंजान शहर में

तुमसे मिलने के लिए तरसती रहूँगी ...

यह जो ज़ज़्बात है मेरे

उन्हें एक हफ़्त में कैसे मैं बया कर दूँ

इसलिए कह रही हूँ

हाँ पहला जन्मदिन कुछ खास सा होता है

यह एक आम दिन है

लेकिन नया अहसास सा होता है

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2nd Position
Shashank Jha
North Central Railway



1st Position
Sudhanshu Ranjan
North Central Railway



3rd Position
Meghana Dattatraya
Western Railway

CE-260224 Duration- 06.05.2024 to 05.11.2024



2nd Position
Sukhjinder
Northern Railway



1st Position
Anu Kumari
Northern Railway



3rd Position
Anand Sahu
North Central Rly

CE-280124 Duration- 15.04.2024 to 13.07.2024



2nd Position
Shaik Hussain
South Central Rly



1st Position
Sangeeth Kumar. B
Southern Railway



3rd Position
Roshan Kumar
Eastern Railway



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