MANUAL
FOR
OPERATION & MAINTENANCE
OF
140 TONNE GOTTWALD CRANE
(1986 DESIGN)
REVISED EDITION-2002

EASTERN RAILWAY
LOCOMOTIVE WORKSHOP
JAMALPUR
ISSUED: - DEC'2002

Railway Crane

User's Manual

General (Part-I)

140 TONNE DIESEL HYDRAULIC B.D.CRANE WITH 'A' FRAME

FOREWORD

The operating & Maintenance Manual contains important references regarding operation, maintenance and care of the crane. They belong in the hands of the crane operator and the Technical Personnel entrusted with the maintenance of the crane.

A copy of the Operating Instructions as well as the Crane Maintenance Spare Parts Catalogue should always accompany the crane.

For 1986 design of 140 Tonne Crane, Gottwald gave a very brief manual, based on which Jamalpur made Operating & Maintenance Manual of about 100 pages in 1995. Since then lot of changes have taken place.

The present manual is a revised & updated version of the 1995 manual in which lot of new concept have been incorporated.

We recommended that you repeatedly read through the operating and maintenance instructions and thoroughly observe the same. Only by sound operation and regular maintenance is the operating safety and long service of the crane warranted.

Operating errors and faulty repairs lead to down-time and avoidable repairs. It lies therefore in your own interests to work in accordance with the operating and maintenance instructions.

Supplementary to these instructions the respective applicable prevention of accident regulations is to be observed.

Should any questions arise resulting from practical operation and which exceed the scope and limits of these instructions, please get in touch with us. We shall be only too pleased to assist you in word and deed and on the other hand we would greatly appreciate any hints or suggestions, which may result from the practical operation of the crane.

Crane Organization
Jamalpur Locomotive Workshop

INTRODUCTION

Accident Relief Train (ART) has always been an integral part of our steam Loco sheds and have been manned by Loco Shed Staff. To help in restoration of traffic, a breakdown crane formed the part of most ARTs. Two types of ART existed, namely, 'A' and 'B' class. The difference between the two was only on the basis of the scale of equipment provided in each. Based on the erstwhile location of steam sheds, there were 141 'A' and 60 'B' class ARTs on the Indian Railways till the early 80s.

Location of the ART and consequently the cranes that they included was based on the location of the sheds. On an average, the ARTs were located about 200 to 250 km apart but were closer at many points.

Bulk of the rolling stock on the ART was fit to run at 90 to 100 kmph. Actual speed was, however, limited to about 65 kmph due to the limitation imposed by the maximum speed of the breakdown crane. Also, most of the cranes were steam powered and of very inadequate capacity, ranging from 20T to 75T. There were only 6 diesel cranes of 120T capacity on the Railways at that stage.

The Railways had in the meantime gone in for heavier and bigger rolling stock. Heavy BOX type wagons had replaced the erstwhile 4- wheeler. Need to reach the site of accident as quickly as possible was also a prime requirement. It, was therefore, decided by the Railway Board in 1981 that new diesel powered cranes of 140T capacity on the BG and 75T on the MG would be inducted into the Railways. At the same time the location of the cranes was fully rationalized on the following basis:

1. 'A' class ARTs would be located so that no point on their beat would be more than 250 kms from its base. These ARTs would be equipped with heavy duty breakdown cranes of 140 T capacity.
2. 'B' class ARTs would be located so that the maximum distance from the site of accident would not be more than 150 kms. Based on this rationalization, it was possible to reduce the number of ARTs from the earlier 201 to 151.

140 TONNE BREAKDOWN CRANE

Keeping the above in view, the Railway Board decided in 1981 that any future design of breakdown crane should be capable of lifting a loaded BOX wagon on the same track. In 1986, 12 cranes were procured from M/s. Jessops, Calcutta. These cranes are based at Parel Workshop, Central Railway for maintenance & POH. Jamalpur was involved in Gottwald design of 140T crane whose manufacture & induction has been done as follows:-

a) 6 complete cranes were imported from M/s. Gottwald in 1986.
b) 3 cranes were imported from M/s. Gottwald in 1987 in Knockdown condition.
c) 3 KIT Crane manufactured at Jamalpur from 1994 to 1997.
d) Jamalpur was given order for manufacture of 21 nos. crane by RB whose progress has been as follows:-

   (i) 4 nos. cranes of 1986 design have been manufactured from 1998 to 2000.
   (ii) 6 nos. crane of 1986 design are under manufacture to be completed in 2002-2003.
   (iii) 11 Nos. crane will be manufactured of new design i.e. 1997 design.

IMPORTANT INSTRUCTIONS

1. Operating the crane requires exact knowledge of the operating instructions.

2. The crane is designed only for operation laid down in the operating instructions and lifting capacity charts.

3. The liability for the safe functioning of the crane must in all cases be borne by the owner or user, when an operation is effected, which does not comply with the conventional utilization.

4. We can not be held liable for damage, which occurs through the non-observance of the following instructions, charts etc.

INSTRUCTIONS ON HOW TO USE THE MANUAL

All sections drawn up in the manual have been numbered. This numbering is maintained throughout, which means that in the respective section under applies to the same component or function in the Table of Contents, the Operating Instructions and the Operation Diagrams.

This manual has been divided into three parts as follows:-

Part I - General
Part II - Operation
Part III - Maintenance

This Manual makes up the User's Manual consisting of several sections. This manual provides you with two options for obtaining the information you desire.

1. You are unfamiliar with the crane and wish to familiarize yourself in turn with all the controls. To do so, refer to the sections listed in the Table of Contents. By following this procedure, you will become familiar with all the safety instructions, the checks required prior to daily start-up and the individual operating steps.

2. You are familiar with the crane and the necessary information. You wish to know the procedure for a particular term. Turn to the Index or the Table of Contents in this manual and you will find the information and / or the function of the operating instrument on the indicated page or in the section number.

The page number has been given section wise in "Page Number/Number of Pages" format. Should any section is revised/updated resulting in increase/decrease in number of pages the entire section should be replaced.

Railway Crane
General

Table of Contents (Part-I)

Railway Crane
General

Technical Data 1

P-1/3

Reference: - RDSO Document No. MP-MISC – 118 (Rev – 0.00)

Dimensions

No. of vehicle in running order – Crane with two 3-axle bogies + Match truck with two 2-axle bogies.

Track Gauge	1676 mm
Wheel diameter (Crane)	in new condition 915 mm
	Condemning 860 mm
Wheel diameter (Match Truck)–For Crane No. **142032 to 142043 & 143001 to 143004** -	New 915mm
	Condemning 860 mm
For Crane No. **143005 to 143010** (Casnub bogie) -	New 1000 mm
	Condemning 906 mm
Wheel set arrangement – 2 non driving – 1 driving – 1 driving – 2 non driving	(2 A) (A 2)
Distance between bogie pivots	7500 mm
Distance between two consecutive wheel sets	1500 mm
Length of Crane over buffers	13300 mm
Over all length	29270 mm
Draw and buffing gear	Hinged buffers and screw couplings
Minimum travelable curve	174 m
Hauling Speed on 90R mainline std track & above	75 km/h
Crane weight in train formation	120 t
Overall Weight (120 t crane + 80 t MT)	200 t
Height in transport position	3950 mm
Width in transport position of Crane & Match truck	3000 mm
Axle load in running order	20 t

Brake System of Crane – Air Brake, Vacuum Brake and Parking Brake:

Primary	Dual-VD-P-12x10 mZ.
Secondary	12 wheel disk-operated brakes 780 mm

For Crane No. 142032 to 142043 & 143001 to 143002
Hydraulic Parking Brake
For Crane No. 143003 to 143010
Pneumatic Parking Brake

Outriggers **Type swing out, 4 Numbers**

Outrigger Base -	**Condition** -	**Propping Base**
	Half Propping -	2.70 m x 11.8 m
	Full Propping -	6.00 m x 11.8 m

Maximum support force	2,200 kN
Outrigger cylinder	Stroke 500 mm
Maximum wheel force	350 kN

Travel Gear

Driven wheel sets on each bogie	1
Speed - Without Load/ with load	12 km/h / 6 kmph

Superstructure

Cab	1 seat/and 1 emergency seat
Over-rear radius	5.5 m

Railway Crane
General

Technical Data 1

P-2/3

Diesel Engine

For Crane No.142032 to 1422043

Make		Cummins USA (Brazil)
Type		NT- 855 R4
Model		6-cylinders in series
	Water –cooled	Exhaust turbo charger
Output		224 kW at 1,800 rpm
Torque		1,158 Nm at 1,400 rpm
Generator		28 V 55 A

For Crane No.143001 to 143010

Make		CIL/PUNE
Type		NTA- 855 R-FFC
Model		6-cylinders in series Vertical
	Water –cooled	Exhaust turbo charger
Output		224 kW at 1800 rpm
Torque		1,158 Nm at 1,400 rpm
Generator		28 V 55 A

Emergency Diesel Engine

For Crane No.142032 to 1422043

Type	Schule-TAF 2
Model	2-Cylinder in series Vertical
	Air -cooled
Output	10.5 kW at 1800 rpm

For Crane No.143001 to 143010

Type	Kirloskar- TA 2
Model	2-Cylinder in series Vertical
	Air -cooled
Output	10.4 kW at 1.800rpm

Main Hoist

Type	3-stage planetary hoist with spring – loaded multi-disk brake		
Rope diameter			26 mm
Rope speed			Max. 80 m / min
Hoist speed -	2.5 m / min ,	Rapid motion	Max. 5 m / min
Hook block		16 strand	140 t
Range of Lift		above track	16. 5 m
		below track	4.0 m

Auxiliary Hoist

Type	2- stage planetary hoist with spring-loaded multi-disk brake	
Rope diameter		22 mm
Rope speed		Max. 60 m/min
Hoist speed		Max. 15 m/min
Hook block		4 strand 25 t
Range of Lift		above track 17.8 m
		below track 3.0 m

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Technical Data 1

P-3/3

Slewing Gear

Type	3-stage planetary hoist with spring-loaded multi disk brake Roller slew ring with internal teething
Superstructure speed	0- 1.0 rpm

Derricking Gear

Type	3- stage planetary hoist with spring-loaded multi –disk brake
Rope diameter	26 mm
Rope speed	Max: 28 m / min
Derricking time from Maximum & Minimum radius	90 Sec

Hauling Winch Capacity **5 t**

Counterweight

Standard duty	29.2 t (5.2 t + 6 t + 18 t)
Heavy duty	43.2 t (29.2 t + 14 t)

Jib	**Box Section (Octagonal)**
Length to the main hook	18 m
Length to the auxiliary hook	18.85 m
Main hook working range	5.5 m— 16.0 m
Auxiliary hook working range	6.5 m – 17 m

Match Truck

Length over buffers	15970 mm
Distance between bogies pivots	11.30 m
Draw and buffing gear	hinged buffers and screw couplings
Turning radius	174 m
Maximum towing speed	75 km/h
Maximum wheel set load	20 t

Brake system of M T Air Brake, Parking Brake:
For Crane No. 142032 to 142037
Disc Brake
Hydraulic Hand Brake
For Crane No. 142038 to 142043 & 143001 to 143004
Tread Brake
Mechanical Hand Brake
For Crane No. 143005to 143010 (High speed Casnub bogie)
Tread Brake
Mechanical Hand Brake

Lifting beam capacity **2 Nos. – 140 t , 70 t**

Compressor **SAB WABCO Axle mounted reciprocating, 7.2 bar**

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General Description 2

Railway Crane
General

Crane Description 2.1

The Gottwald Railway Crane is a Recovery and Accident Relief Crane with a maximum capacity of 14 0 Tonne.

In combination with the uncouplable match wagon the crane is fitted with all the necessary operational components, can be erected in a minimum of time and can travel under its own power.

All crane motions are carried out hydraulically and controlled from the spaciously glazed cab. The hydraulic pumps are driven by a diesel engine.

Extensive safety devices continuously monitor the loading on the crane, the position of the boom and hook block, the slewing range and the counterweight which is mounted. The hydraulic system is protected by means of check valves in case of pipe or hose fractures.

The hydraulically operated stabilizing devices mounted on the undercarriage enable a 360 degree working range of the crane also with maximum loads.

- **JIB**

  Jib is of articulated and cranked type so that the jib foot-pin is fully relieved of all stresses arising from the crane passing over curved track with buffers in full compression and jib resting on trestle of match truck. Jib stopper rest is provided on the top to prevent backward swing of jib from maximum position (due to storm or otherwise). Jib is lifted by two gantry ropes one of which is fitted with load sensing devices. Boom angle sensor is mounted on the fork end inner side.

- **'A ' FRAME**

  In large cranes derricking forces can be very high. To accommodate these forces a frame shaped like an 'A' is located on the tail side of the crane that helps in the derricking.

- **HOOKS**
  The main hoist of the crane is provided with a ramshorn hook of 140 tonne capacity supported on thrust ball bearing to allow free swivel even under loaded condition. An auxiliary hook of shank type for a safe working load of 25 tonne capacity is also provided.

- **UNDERCARRIAGE**

  Crane undercarriage is pivoted on two bolsters which are mounted on three axle bogie wheels provided with disc brake due to which wear of the motion on rail goes to tread and braking wear goes on disc. Each wheel is braked with double jaw disc brakes by separate pneumatic cylinders.

- **BOGIES**

  The running gear of the crane comprises two 3-axled bogies.

  The wheel sets are mounted in a hinged frame and spring suspended up to bogie centre section by means of coiled and disc springs.

  The spring suspension is blocked with hydraulic cylinders for crane operation. Each wheel is braked with double jaw brakes by means of a separate air pressure cylinder. To enable the crane to travel independently from train order one axle of each bogie is fitted with a separate engagable drive assembly.

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- **SPRING SUSPENSION**

  The bogie spring suspension is provided purely for hauling operation. By self propulsion and by crane operation the spring suspension will be blocked through hydraulic cylinders. A control valve and a monitoring device on the side of the undercarriage serve for this purpose. When operating the crane for long periods the oil leakage losses of block cylinder must be checked by means of the gauge (fall of pressure) and, if necessary, the cylinder is to be re pressured.

  Through operating the spring suspension blocking the traction gear sliding pinion will be engaged and the brake system switched over to crane operation.

- **SLEWING RING**

  Slewing ring is a large size roller bearing mounted horizontally and connecting under carriage and superstructure (while permitting rotations of Superstructure and under carriage). This is specially designed to accommodate oscillating moments. Slewing ring comprises of inner ring and outer ring. Inner ring has gear teeth which mesh with slewing gear pinion mounted on slewing gearbox. The inner ring and outer ring have 64 holes each. The outer ring is fastened with superstructure and inner ring with undercarriage by long studs. The slewing ring permits rotation of the superstructure on under carriage and accommodates tilting movement as well as axial and radial loads.

- **SLEWING MECHANISM**

  By provision of slewing pinion driven by a hydraulic axial piston motor, complete slewing with speed of 360 degrees rotation per minute has been provided. Slewing motor is supplied oil from a closed hydraulic circuit which ensures extreme sensitive and jolt free slewing of the crane. The lamina brakes engage automatically at the end of the slewing motion and disengage automatically at the beginning of any slewing motion.

- **ROTOR**

  The Rotor is mounted on the undercarriage in the centre of the slewing ring and it connects hydraulic and air system of superstructure and undercarriage.

- **ROPE WINCHES**

  The crane is fitted with two single rope winches for main and auxiliary hoists as well as a double rope winch for derricking the boom in and out. Each winch gear and rope drum form a compact sub-assembly and comprises of internal planetary gear, built-in lamina brake and flanged hydraulic motor.

- **RECOVERY WINCH**

  The crane is additionally equipped with a recovery winch, which enables max. 50 kN line pull. The rope is guided over fairlead rollers from the rear mounted winch up to the crane cab, where it emerges through a propeller roller. This propeller roller permits an offset line pull up to 45 degree in all directions.

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- **LAMINA BRAKE IN CRANE MOTION**

  The lamina brake is conceived purely as a holding brake.

  In main hoist drive, auxiliary hoist drive, derricking drive, slewing drive and salvage winch motors, lamina brake has been provided. The drive assembly consists of hydraulic motor, gear box with build in lamina brake and rope drum. This arrangement provides safety in case of damage to the circuit and prevents free fall of the load/ motions.

  In case of main/auxiliary hoist and derricking drive, while lowering, pressurized oil releases lamina brake. When the load is getting lifted up, the check valve provided in the brake valve attached to the hydraulic circuit prevents falling of the load in case the, motor is not able to produce the required torque to lift the load. While lowering the load lamina brake is released and the throttle provided in the brake valve permits smooth lowering of the load.

  While lifting or lowering when the motion is stopped above the ground, due to drop in pressure lamina brake gets applied and hold the load at the same position. This ensures safety in crane motion.

- **OUTRIGGERRS**

  The outriggers comprise 4 swing-type telescopic beams, each fitted with a vertical outrigger cylinder at the end. Extending and swinging out the beams is carried out simultaneously by means of a hydraulic cylinder.

  According to space and operating conditions the crane can be propped in both swing limited positions. Outrigger bases are (i) 11.8 m x 2.7 m (ii) 11.8 m x 6.0 m.

- **COUNTERWEIGHTS**

  Counterweights are mounted on the Superstructure as per requirement of load condition. Sensing of or no counterweight is done by pressure switches provided with the counterweight gallows hydraulic cylinder and it is transmitted to the SLI system and also indicated in the driver's cabin.

  In transport position the lower counterweight section basically remains in the mounting on the undercarriage. All other sections are on the match wagon. According to mode of application the crane can be operated with 29.2T/43.2T counterweight.

- **TRACTION GEAR**

  The hydraulic traction gears permit the crane to be traveled at a speed of max: 12 km/hr.

  In the inner wheel of the crane bogie, traction gear is mounted during travel mode, traction pinion meshes with the gear operated by pneumatic cylinders.

  This occurs if axle blocking is operated. With Axle blocking, brake is applied on the crane wheels. When the driver operates the control lever for traveling of the crane, brake opens automatically.

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- **MAIN POWER PACK**

  Main power pack is a horizontally mounted, six cylinder diesel engine with super charger. The main power pack at the radiator end drives two pumps (Q6 & Q7) and at the opposite end, is flanged with the transmission box and drives 5 pumps (Q1 to Q5). The main power pack also drives the main compressor and the three phase alternator through belt drive, both at the radiator end.

- **AUXILIARY POWER PACK / EMERGENCY ENGINE**

  This is a smaller capacity vertically mounted, two cylinder type diesel engines (starting through hand cranking) located on the radiator side of the main power pack failure.

  The auxiliary unit comprises a diesel engine as well as 2 – flanged hydraulic pumps, which generate the working and control pressures for the auxiliary operation.

  After starting the auxiliary diesel assembly the auxiliary pumps deliver in the first instance pressure less to the tank. When operating a control lever in the cab the delivery flow will be automatically switched to the respective working circuit. Due to the low power machine the working motions may only be carried out individually and the traction gears not used.

- **CABIN**

  The Driver's cab of this crane is mounted on superstructure front and is located between the jib fork, thus providing a clear view of its working area.

  As you enter the cab, on the front panel facing the cab door are displayed three load charts. These load charts indicate safe working load at a particular radius and the permissible slewing area for various combinations of counterweight and outriggers. These charts are for the guidance of the crane driver.

- **MATCH TRUCK**

  Match truck is mainly for carrying Jib, Counterweights, Main and Auxiliary Snatch block, Ropes and tackles. The location of weights, tackles, lifting beams and jib head is placed so as to distribute the load evenly and keep the axle load within limits.

  When being hauled the match wagon serves to straw the hook blocks and the boom head. Through placing the counterweights on the match wagon the axle loadings of the crane for hauling operation will be reduced to the required loadings. The match wagon also serves to stow the outrigger pads and slings etc.

  The match wagon under frame is fitted with the required mounting devices (brackets etc.), stowage bags and the boom support. The buffing and draw gear is mounted on each crane at the front.

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In the 140T Breakdown Crane of Gottwald make all motions are through fluid power. Power is transmitted and controlled through either oil or air under pressure.

HYDRAULIC CIRCUITS OF 140T B.D.CRANE

In the 140T crane, various crane operations are performed with the help of Hydraulic Motors and hydraulic cylinders. The motors are fed with oil under a very high pressure with the help of Heavy Duty Hydraulic Pumps.

The pumps are driven directly by the Diesel Power Pack through P.T.O (Power-take-off) or "V" belts as per design and requirement.

HYDRAULIC PUMPS

	Main Pump	**Slewing Pump**	**Control circuit Pump**	**Cooling Pump**	**Oil cooler Pump**	**Emergency Pump**
Type	Variable axial piston: A7VO 160 HD	Variable axial piston: A4 V71 HD	Gear	Gear	Gear	Gear
Make	Rexroth	Rexroth	Rexroth	Rexroth	Rexroth	Rexroth
Displacement (lpm)	40-240	Q3 - 150 Q4 - 30	50	50	32	Q8 - 36 Q9 - 14
Max. pressure (bar)	280	Q3 – 200 Q4 - 30	30	140	60	Q8 – 280 Q9 – 30
Application	Main hoist, Aux hoist, Traveling gear, Counter weight, Derricking, recovery winch, Outriggers, Propping, Axle blocking	Slewing circuit	Control circuit	Water cooling	Hydraulic oil cooling	Emergency stowage
No of Pumps/Crane	2	1+ 1	1	1	1	1 + 1
Designated as	Q1 & Q2	Q3 & Q4	Q5	Q6	Q7	Q8 & Q9
Fitment	P.T.O. Unit	P.T.O. Unit	P.T.O. Unit	Engine Mounted	Engine Mounted	Aux. Engine Mounted

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HYDRAULIC MOTORS

Type	**Main hoist motor**	**Auxiliary hoist motor**	**Derricking motor**	**Slewing motor**	**Winch motor**	**Travel motor**
	Fixed displacement A2FM180/61	Fixed displacement A2FM 180/61 & *A2FM 125/61W-PAB XXO-S	Fixed displacement A2FM 180/61	Fixed displacement A2FM180/61 & *A2FM 125/61W-PAB XXO-S	Fixed displacement A2F 63/61 & *A2FE 63/61W-VZ/100	Fixed displacement A2FM180/61
Make	Rexroth	Rexroth	Rexroth	Rexroth	Rexroth	Rexroth
Displacement	180 cc/rev	180 cc/rev	180 cc/rev	180 cc/rev	63 cc/rev	180 cc/rev
Max pressure	280 bar	280 bar	280 bar	280 bar	280 bar	280 bar
No of motors/ Crane	1	1	1	1	1	2

*

These motors have been used in following gear boxes, which has been supplied by Gottwald. During manufacture of crane at Jamalpur, these gear boxes have been fitted in crane nos. 143007 to 143010.

Location	Gear box make	Model	Motor type
Auxiliary	L&S	GFT 40 W2 9252	A2FM 125/61W- PAB XXO-S
Slewing	L&S	GFB 60 T3 1033	A2FM 125/61W- PAB XXO-S
Recovery winch	L&S	GFT 17 W2 4297	A2FE 63/61W- VZ/100

HYDRAULIC CIRCUIT IN BRIRF

The pump Q5 is termed as “PILOT PUMP” This pump operates the main spool valves by supplying continuously pressurized oil at 30 bar at the rate of 15 litres/min.

The pilot pump Q5 immediately starts sending oil to the pressure gallery just after the main power pack is switched on. The oil is continuously available in the pressure gallery at 30 bar as long as the power pack is running. It can be tapped through different operating levers for obtaining desired motion of the crane.

The pilot circuit has been designed to operate the “Power Circuit” from which we get the desired motions. Power Circuits are of two types

(a) Open circuit with pump Q1& Q2.
(b) Closed circuit with pump Q3.

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Hydraulic System 2.2

Hydraulic oil at a high pressure of 280 bar is made available to the main spool valve block M1 & M2 by the pumps Q1 & Q2. By operating the Directional control valves (Main spool valves) fitted in valves blocks M1 &M2, the desired motions are obtained. As these valves operate under high pressure (280 bar) and flow conditions, they have been designed to be operated hydraulically with the help of hydraulic power supply (30 bar) from the pilot circuit. Thus we see that two simple circuits, i.e. Pilot & Power circuits have been combined together to form a composite circuit for easy and smooth operation of the crane.

Let us analyse one of the main circuits, namely, hoisting circuit. This will be helpful in further study of the other hydraulic circuits. Pilot circuit comprises of the following equipment:

(a) Pilot pumps Q5.
(b) Pressure relief valve (30 bar)
(c) Operating levers
(d) Tank with Hyd. Oil
(e) Solenoid valves for safety circuits

With operation of the hand lever the oil at 30 bar is diverted to:

(a) Solenoid valve.
(b) Directional control valves (Main spool valves) in blocks M1.
(c) Variable displacement pump Q2

In pilot circuit, one solenoid valve has been inserted in such a way that as Main Power Pack builds up safe lubricating oil pressure, the solenoid valve gets energized and the passage of oil to tank is stopped completely. The electrical connections are made through various units, limit switches and computer relays so that in case of exceeding the limit from pre-determined data, the line gets cut off and the solenoid valve allows the free flow of hydraulic oil of the pilot circuit to the tank, thus canceling further operation in the power circuits and maintaining safety at once. By the operation of the hand lever and going ahead in the pilot circuit it may be seen that the main spool valve is shifted either way depending upon the mode of operation of the lever.

Let us first consider the Hoisting “UP” operation The Directional Control Valve is to be shifted left to right as per the direction. The pressurized oil, from the pump Q2 via main spool valve block M1, enters the hoisting motor through a non-return valve (Check Valve) fitted in the brake valve (22 bar). In case of failure of power, the falling back of the load lifted is stopped due the check valve, coming in front, as it stops the return oil to flow back to the tank. In this case lamina brake remains engaged and motion is permitted in hoisting up direction through permitted direction of anti-freewheeling arrangement of drive shaft.

Similarly in the Hoisting:" DOWN" operation, the operating lever is to be shifted in opposite direction, thus shifting to the main spool valve from right to left .The hydraulic oil at a pressure of 120 bar flows to the motor as given below:

(a) Pushing the brake valve block (22 bars) to the left to provide for the return of oil through choke valve. Provision of choke valve controls the hoisting down speed.
(b) Overruling the freewheeling arrangement due to release of lamina brake system.
(c) Lowering the load by revolving the hydraulic motor in reverse direction.

In case of failure of hydraulic power (in hoisting down operation) for any reason the load ceases to fall down on account of the following reasons:

(a) The brake valve block shifts back to its original position thus stopping the oil to pass through the check valve, which comes in front due to absence of Hydraulic pressure from the lowering circuit.
(b) The lamina gets engaged and prevents rotation of extended drive shaft.

Thus two types of safety precautions have been provided to the load lifted in addition to SLI system monitor, i.e. free wheeling arrangement (Mechanical) with lamina brake and brake valve (Hydraulic).

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Railway Crane
General

Air Pressure System 2.3

Air pressure system in the crane carries out the following operations:

- Operations of the brake cylinder.
- Engaging the traction gear pinion.
- Operations of condition indicators for service brake, hand/parking brake and spring suspension blocking.
- Signal horns.

When the main power pack of crane works, the entire air pressure system is charged by the main engine air compressor. The pressure regulating valve keeps the pressure in the range of 6.2 to 7.3 bar. The pressure is indicated by a gauge in driver's cabin. An air oiler mixes small quantity of oil with air for lubrication of pneumatic valves and equipment. Condensed water from the system can be removed by means of drainage valve provided in air supply tanks.

- **BRAKE SYSTEM**

a) The undercarriage is equipped with air brake system but can be integrated in both vacuum brake and compressed air braked train order. For this the corresponding hose couplings must be connected and the brake valves switched over with side mounted hand levers. Each bogie has a total of 6 compressed air brake cylinders, whose double jaws act on the discs mounted on wheels.

b) **Hauling in Train order with compressed air brakes** – The air supply tanks of the carne are charged by means of the main tank air line. The brake and release operations are controlled by continuous brake line of the carne.

c) **Hauling in Train order with vacuum brake -** In this case, the crane has to be changed over to the vacuum controlled compressed air brake system, which means that the brake and release impulses come via the train order vacuum line, however the braking force itself is still generated with compressed air. Two air compressors serve to charge the air tanks, which are driven by the bogie axles.

d) **Self propelled crane travel -** In uncoupled condition of the undercarriage, brake system is supplied air from the compressor on the crane's main drive assembly. The air pressure is directed by means of a rotor to the undercarriage air tanks. When the spring suspensions blocking is engaged, the brake also closes. By operating the travel control lever, the brakes open and when the control lever is pulled back to neutral position the brakes are automatically engaged again.

In addition, independent of the position of the control lever, braking can be initiated by foot valve in the cab. Slow motions of the control lever and simultaneous braking enable the crane to be braked very smoothly when traveling with load.

Railway Crane
General

- **PARKING BRAKE**

  While leaving the crane on site or in yard (in every case when the diesel engine is not running), the parking brake must be applied. On track with more than 3% gradient, additional wedges should be used to protect the crane from rolling. By turning the parking brake hand wheel, the brake jaws will be closed by means of a piston pump and additional hydraulic cylinders on each brake cylinder per axle. The respective brake condition (open/close) is signaled by side mounted indicator device.

  In crane numbers 143003 to 143010 the parking brake design has been changed from hydraulic to pneumatic. The brake cylinders on each axle bogies have also been changed from hydraulic to pneumatic. The parking brake in these cranes is operated by a lever in under frame in stead of hand wheel in the hydraulic system of the earlier cranes.

- **MATCH WAGON BRAKE SYSTEM**

  Each match wagon bogie wheel is braked by means of a double jaw brake with a separate air pressure cylinder. One of the brake cylinders per axle is fitted with a hydraulic cylinder which is pressurized by the hand brake and closes the corresponding brake.

  From crane numbers 142038 to 142043 and 143001 to 143010, tread brake type bogies have been fitted in MT. The operation of the brakes is done by two pneumatic brake cylinders (one each for each bogies) similar to the brake systems of the BOX ”N” wagon.

  Contrary to the crane undercarriage, match wagon brake system is only in operation in compressed air braked train order and by self-propulsion in combination with the crane. When being hauled in vacuum braked train order the compressed air brake will be shut off and the through vacuum brake line connected. In this condition there are no brakes in the match truck.

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Railway Crane
General

INTRODUCTION

I. In the 140T Diesel Hydraulic Crane, the electrical system has very important role, the entire safety of the crane hinges on the functioning of the electrical components fitted in the crane.

Due to very high pressure and rate of flow (280 bar), the power circuit valves cannot be operated by hand. Therefore a low operating pressure (in pilot circuit) of 30 bar is used to operate the control valves manually, which in turn operates the power circuit valves. All the electrical safety components are incorporated in the 30 bar control circuit

While operating the crane if the operator exceeds the safe working parameters (such as working radius) and overload conditions are approached, the electrical components, such as limit switches, load cells and angle sensors respond and interrupt the power to solenoid valves (of pilot circuit) thus connecting concerned pilot line to tank, thereby stopping the concerned motion.

II. The 24 V electric system of the crane is supplied from the generator. The charging current of the generator is indicated by an ammeter in the crane cab. The generator has the following functions:

- Charging the starter batteries
- Supply to safety devices, comprising Control unit, display console, limit switches, boom angle sensor, slewing angle sensor, load cells in gantry wire rope, pressure switches in counterweight cylinder and solenoid valves
- Crane and job site (for hand lamp only) lighting
- Engine monitoring instruments
- Elect. Magnetic engine stop devices
- Cab fans and screen wipers

LIMIT SWITCHES

Gear Cam Limit Switches –

These cam type limit switches are fitted with following gear box drums and are driven by them through reduction gear (a part of limit switch). They cut off power to rope winches whenever the operator exceeds the working parameters. The limit switches are pre-set. The setting can be adjusted by coarse setting as well as fine setting. The correct settings of limit switches should be ensured at all times.

Main Hoist Limit Switches

a) 15 S 11 Anti two block limit
b) 15 S 13 2nd Hoist position selected when de rigging.
c) 15 S 12 Lower limit (Minimum number of turns of hoist drum)

Auxiliary Hoist Limit Switches

a) 15 S 111 Anti two block limit
b) 15 S 131 2nd Hoist position when de-rigging.
c) 15 S 121 Lower limit (Minimum number of turns on drum)

Boom Limit Switches

a) 15 S 112 While derricking "IN" minimum working radius 5.5 M.
b) 15 S 113 While derricking "IN" steepest boom position (for Counterweight erection position 5 m).
c) 15 S 122 While derricking "OUT" max. working Position 16 m
d) 15 S 123 Minimum number of turns left on the drum

Recovery Winch Limit Switches

a) 15 S 114 Winch "IN" position.
b) 15 S 124 Winch "OUT" (Minimum number of turns on drum).

Roller Type Limit Switch

Roller type limit switch is fitted on top of the gallows frame. It cuts off power supply to solenoid valve when the counter weight gallows cylinder has risen to approximately 822 mm (full stoke of the cylinder is 825mm). When the limit switch is cut off, a glowing indication lamp switches off in the operating cab, indicating that the counter weight gallows are at the appropriate height.

SOLENOID VALVES

Solenoid valves are also called magnet valves. The valves are incorporated in series with limit switches, load cells or angle sensors. A glowing indication lamp indicates that the solenoid valve is energized.

Whenever the operator exceeds working limits, limit switches or load sensor/angle sensor etc. responds by cutting off supply to the concerned solenoid valve. The control pressure drops from 30 to 0 bar. As there is no pressure in the control circuit, the power circuit is interrupted and the motion stops.

To ensure safety of the crane, Solenoid Valves are so operated that even if the limit switches or the cable connections are damaged during operation, the hydraulic valve can be operated, to enable the crane motion to be fully carried out. This can be done by manually bridging the solenoid valve by pressing the spring loaded push button on the valve. ***When a solenoid valve is bridged, safety devices of the crane are no longer operative.***

The following 11 nos. solenoid valves have been fitted in the crane:

a) 15Y11 - Main Hoist "UP"
b) 15Y12 - Main Hoist "DOWN"
c) 15Y111- Aux. Hoist "UP"
d) 15Y121- Aux. Hoist "DOWN"
e) 15Y112- Slewing "Slew Left"
f) 15Y122- Slewing "Slew Right"
g) 15Y113- Derricking "Derrick IN"
h) 15Y123- Derricking "Derrick OUT"
i) 15Y114- Recovery Winch "IN"
j) 15Y124- Recovery Winch "OUT"
k) 15Y125- Counterweight Gallows

ELECTRICAL SYSTEM (OPEARATION)

When Accumulator Main switch 7Q3 (in arrangement 7A1) is switched 'ON', positive feed is available (via ammeter 7P2 and fuse 7F 01.1 50A) at cable no.1 (feeding arrangement 7A 2.1) and (fuse 7 F02.1 16A), feed is available up to ignition switch 7Q8 and feed is also available at normally open contact of 87 of main relay 7K51.

When ignition Key 7Q8 (in arrangement 7A2) is switched 'ON', main Relay 7K51 is energized.

As the coil of 7K51 is energized the normally open contact of 7K51will be closed (in arrangement No.A1). This feeds cable No.5 and also feeds tune off magnet valve 7YOI via fuse 7FO2.3 16A and stop push button switch 7S51.

Cable No.5 feeds positive from arrangement No.7A 1.8 to Cable No7 in arrangement 7A2 and 7A 3.1 via fuse 7FO2.2 16A.

In arrangement No. 7A3, relay 7KO3 is energized via Lube Oil Pressure switch 7B5.

When relay 7KO3 is energized, the normally open contact (87.30) of 7KO3 closes and feeds B1 of Relay 7K030.

Arrangement – 7A1

As relay 7K030 is energized normally closed contact (15, 16) is open and normally open contact (15,18) closes. This closing of contacts (15,18) gives positive feed to cable No.6, as cable No.6 gets positive feed , an indication lamp 7H74 glows in the cabin (Low lube oil pressure) as shown in arrangement 7A3. It is applicable for **Crane 142032 to 142043. For Crane No. 143001 to 143010**, normally closed contact (15,18) of relay 7K030 gives positive feed to cable no. 6 , as cable no. 6 gets positive feed, an indication lamp 7H74 glows in the cabin (low lube oil pressure) as shown in arrangement 7A3.

As contacts 15, 16 of 7K030 (in arrangement 7A1) is open 7P41 Hour meter and relay 7K01 (start Blocking) and relay 7K02 (safety equipment) are de-energized.

As there is no feed in relay 7K01, the normally closed contact (30, 87a) of relay 7K01 remains closed, and as the start push button 7S52 is pushed, the engine start relay 7K52 is energized. When relay 7K52 is energized, it closes the normally open contact (87, 30) of relay 7K52 and with this the starter gets the feed.

As soon as the lube oil pressure builds up (arrangement No 7A3) pressure switch 7B5 breaks the circuit of relay 7K03. This in turn opens contacts (30, 87) of 7K03 and breaks the feed at B1 of Relay 7K030 for **Crane 142032 to 142043. For Crane No. 143001 to 143010 a**s soon as the lube oil pressure builds up (arrangement No 7A3) pressure switch 7B5 breaks the circuit of relay 7K03. This in turn closes contacts (30, 87a) of 7K03 and feed to A1 of relay 7K030 and it will be energized.

As there is no feed at B1 of relay 7K030 the contacts (15, 18) is open and contacts (15, 16) closes. This affects the following:

(i) No feed at Cable No.6 (Arrangement 7A3) - Lamp off.
(ii) Relay 7K01, 7K02 and Hour meter 7P41 are energized.

As the relay 7K01 is energized the normally closed contact (87a, 30) of relay 7K01 opens and this stops the starter motor being engaged whilst engine running.

Arrangement – 14MI

Cable No. 5 is fed positive from Arrangement 7A1.8 and feeds the following circuits via fuse 7F02 4 (16A).

(i) Switch 14S41 for wiper motor 14E41 of front pane.
(ii) Switch 14S45 for wiper motor 14E42 of roof pane.
(iii) Switch 14S43 for left fan 14E91.
(iv) Switch 14S44 for right Fan 14E92

Arrangement 14M2

Cable No-5 is Fed positive from arrangement 7AI.8 and feeds the following lighting circuits.

a) Through Fuse 7F02.5 16A, switch 14S46 for cabin light 14E220 and switch 14S47 for Engine cabin lights, 14E221 and 14E222 and through switch 14S441 for dash board lighting.
b) Via fuse 7FO2.7 (16A) switch 14S40 for Jib lighting 14E230 and 14E231.
c) Through Fuse 7FO2.8 16A, Switch 14S48 for roof lighting 14E232 and switch 14S49 for superstructure lighting 14E234.

Arrangement 15-MI

Cable no.5 is fed positive from 7A1 and feeds the following circuits via fuse 7F02.6 16A.
Relay 7K02 (arrangement 7A1.5) normally open contact (87.30) closes, when relay 7K02 is energized, via contact (87, 30) of Relay 7K02, the following circuits are fed.

a) Solenoid valve 15Y11 - Main Hoist lift 'UP' through relay 19KO40 (Feed via SLI Arrangement 19MI.1) and limit switch 15S11.
b) Solenoid valve 15Y12 - Main Hoist 'lowering' via limit switch 15S12.
c) Solenoid valve 15Y111 - Aux hoist lift 'UP' through relay 19KO41 (Feed via SLI Arrangement 19 MI.2) and limit switch 15S111.
d) Solenoid valve 15Y121 - Aux hoist 'lowering' through limit switch 15S121.

e) Solenoid Valve 15Y112 - Left slewing gear through relay 19K21 (Feed via SLI Arrangement 19MI.6)
f) Solenoid Valve 15Y122- Right slewing gear through relay 19K11 (Feed via SLI Arrangement 19 MI.7)

Relay 15KOI, should always be powered except when aux engine running, then over bridges relay 7KO2, powering safety circuits.

Arrangement 15M2

Cable No.1 is fed positive from 15 MI.8 and feeds the following circuits

a) **Solenoid Valve 15Y113** - "Luffing" through limit switch 15S112 for upper working position and limit switch 15S113, for upper position. Jib and relay 19K18 (Feed via SLI Arrangement 19 M2.6)

   15S51 - Short out upper working position.

b) **Solenoid Valve 15Y123** - "Derricking out "through relay 19KO42 (Feed from SLI arrangement 19MI.2) and limit switch 15S122 Lower working position and limit switch 15S123 lower rope layer.

   15S51 - Short out, lower working position.

c) **Solenoid Valve 15Y114** - For wind up of recovery winch, through limit 15S114.

d) **Solenoid Valve 15Y124 -** For wind off recovery winch, through limit switch 15S124.

e) **Solenoid Valve 15Y125** - Counterweight lower position, through limit switch 15S125.

   An indication lamp 15H71 glows in the cabin via limit switch 15 S 125 (closed contact). When the counterweights are fully raised the limit switch 15S125 breaks the circuit and the lamp goes off.

Arrangement 19M1

Cable No.5 is fed from arrangement 7A1.8 and feeds through fuse 19F3 to Central Unit of SLI DS350D and energizes overload relay 19K040, 19K041, 19K042 and also feeds through 19S40-shorout overload.

Arrangement 19 M2

a) Relays 19K21 (switching off-slewing gear left) and relay 19K11 (switching off-slewing gear right) are fed from the Central Unit of the SLI.
b) Cable No.1 is fed positive from arrangement 15 MI.8 and feeds the following:
   (i) Relays 19K13 and relay 19K14 via pressure switch 19B52 (29.2T)
   (ii) Relays 19K15, 19K16, 19K17 via pressure switch (43.2T).

   Relays 19K18—Energized by SLI in circuit with "Derricking in"

Railway Crane
General

LIST OF RELAYS AND FUNCTION

7KO30 - Time delay Relay Powers 7K01 & 7K02 when engine running (operates through contact in 7K03) Low Oil Pressure.

7K51 - Main circuit relay- Energized when ignition 'ON' selected.

7KO1 - Stops starter motor being engaged whilst engine running (start blocking).

7KO2 - When energized brings all safety equipment into operation.

7KO3 - Engine Low oil pressure- switches over priority relay 7KO30- stops all crane motions.

7KO4 - Engine oil Temperature- Puts warning light on in operators cab.

7KO5 - Engine overheat relay- Puts warning light on in operators cab.

*19K041- Over load Relay energized through central unit, it also be energized when SLI over bridge key selected over bridges- Aux hoist "UP".

19K18 - Energized by central unit in circuit with Derrick" In" – switches off at 8 m radius – 43.2 T C/W free on rails.

*19KO42 - Over load Relay energized through central unit, it also be energized when SLI over bridge key selected over bridges – Derrick "OUT".

*19K040 - Over load Relay energized through central unit , it also be energized when SLI over bridge - Main hoist "UP".

14KO1 - In circuit with WIPER motors, operators cab key selected over bridges.

15KO1 - Should be always powered except when aux. engine is running, then over bridges 7KO2 powering safety circuits.

15KO2 - Main hoist – second limit switch change over, de-energized when boom over bridge key selected.

15KO3 - Aux Hoist- second limit switch change over, de-energized when boom over bridge key selected.

**19K13 - Energized by 29.2T C/Wt pressure switch- contacts in relay select correct 29.2T SLI channel.

**19K14 - Energized by 29.2T C/Wt pressure switch- contacts in relay select correct 29.2T SLI channel.

19K11 - Powered from SLI unit contact in series with "Slew right" solenoid valve.

19K21 - Powered from SLI Unit – contact in series with “slew left” solenoid valve.

**19K15 - Energized by 43.2 T C/Wt pressure switch – contact in relay select correct 43.2 T SLI channel.

**19K16 - Energized by 43.2 T C/Wt pressure switch – contact in relay select correct 43.2 T SLI channel.

19K17 - Energized by 43.2 T C/Wt pressure switch – contact in relay select correct 43.2 T SLI channel.

7 K52 - Engine start relay.

**** - When no C/Weight is fitted, relay sequence automatically selects “O” channel in SLI.

* - 19KO41, 19KO42, 19KO40 are powered through relay contact in side SLI - over load breaks. Circuit and via relays stops motion- relays can be re-energized by keying in “SLI over bridge” key.

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Railway Crane
General

General

The crane is fitted with a series of automatic acting safety devices, which should prevent accidents and damage to the crane.

To ensure perfect operation of the safety devices the following is to be observed:

1. All limit switches; force and angle sensors must be operational, fitted and cabled. Damaged cables must be immediately replaced.
2. The switching point of the cam limit switch may not be changed. Consequently when coiling never pull the rope ends round the drum or rotate the empty drum when changing the rope.
3. The electric solenoid valves for cut – off function may not be bridged.
4. All limit switches must be checked when rigging to ensure function.
5. The safety devices bridging switch and the limit switch are solely for rigging/ de-rigging and may not be operated during operation.
6. The safe load indicator does not release the crane user from his responsibility to thoroughly determine the weight of the load to be lifted and to check the admissibility of the operation according to the lifting chart.
7. The crane axles must be vertically leveled.
8. The storage of rigging condition date in the safe load indicator must be accurate and effected according to the operating instructions in Annex.

Danger Instructions

Your special attention is drawn to the fact, that even when all safety devices function certain operating errors resp. non- permissible operating conditions are not sensored or the cut- the of the motions is effected too late.

This especially applies for:

- hook block or hoisting accessories
- pendulum motion of load
- breaking loose loads, which are struck
- loads falling into rope
- diagonal pull
- subsoil cave –in
- inadmissible high wind forces
- hoisting an inadmissible heavy load through derricking in the main boom

Automatic safe load indicator

Setting, mounting, method of operation and control of the automatic safe load indicator is fully described in the separate operating instruction in Part-II.

Prior to work operation the safe load indicator selector switch must be set at the required outrigger basis. The respective counterweight combination will be automatically passed to the unit by means of a pressure switch and indicated through pilot lights.

When operating the unit constantly indicates the working radius, the possible load and the existing load.

When exceeding the admissible max. load moment, all load moment increasing crane motions will be switched off. The unit warns the crane operator beforehand through visual and audible signals.

Likewise the safe load indicator monitors the permissible slewing angle of the crane, dependent on the size of the load and type of outrigger basis, and where required switches off the slewing gear.

Switch to bridge the safe load indicator

The switch may only be operated during the duration of the following rigging conditions:

When rigging the unstabilized crane during transportation of the individual counterweight sections from the match wagon to the undercarriage and accordingly in reverse when de-rigging the crane.

When this is being carried out the crane may not be rotated. After completion of the operation the safe load indicator must be immediately switched on.

In all other rigging case and during crane operation the safe load indicator may not be bridged.

Cam limit switches on rope drums

All rope drums drive respective cam limit switches by means of reduction gears, which cut-off the rope winches by the following operating conditions:

Derricking gear: - steepest working position of boom
(can be bridged to pick –up the counterweights from undercarriage)
- Max. working radius of boom (can be bridged to lower the boom)
- when boom is down and two windings on the drum

Hoists I + II : - highest hook position
- two windings on drum

Recovery winch: - rope fully coiled
- two windings on drum

The switch points are pre-set at works and may not be changed through rotating the empty drum, e.g. when changing the rope.

Solenoid valves

The respective hydraulic working circuits will be interrupted by means of solenoid valves, when the electrical devices respond (limit switches, safe load indicator).

Due to safety reasons the solenoid valves are so operated, that even if the limit switches or the cable connections are damaged during operation, they still respond. To enable the crane motions to be fully carried out, the solenoid valves can be manually bridged. For this purpose the spring load push button on the valve is to be pressed. Should a second person not be available, the button can be fixed with a pin.

C A U T I O N

In this case the crane's safety devices are no longer operative.

Railway Crane
General

Capacity and Load Moment 2.6

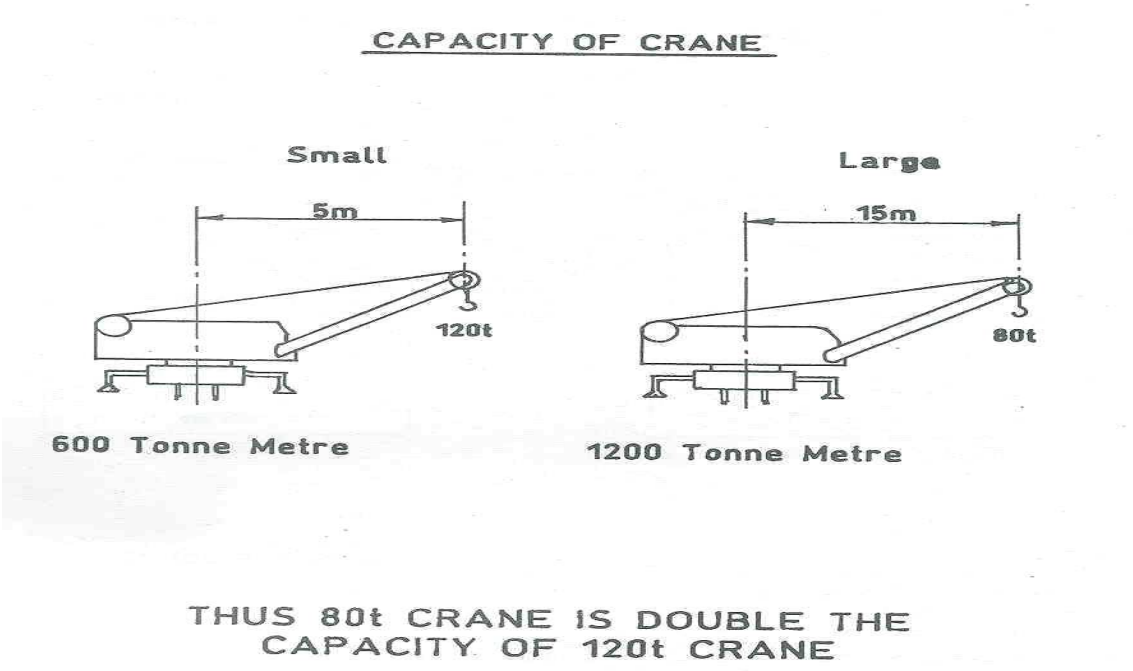
P-1/1

Capacity of a breakdown crane is usually expressed in tones. For example, the crane under discussion is the 140T Crane. This figure is actually the capacity of the lifting hook and therefore is a misnomer. The term that describes the capacity of a crane more correctly is the load moment, which is defined as the load that can be lifted in tones multiplied by the radius at which it is lifted. For example, the 120 T diesel crane (available in IR) can lift this load at a radius of 5 meters only so that its load moment is 600 tonne-metres. On the other hand, an 80 tonne crane that can lift this load at a radius of 15 metres has a load moment of 1200 tonne-metres. The 140 T Gottwald Crane lifts its 140 tonne at a radius of 9 metres, so it has a load moment of 1260 tonne metres. It is thus seen that the 80 tonne crane has a capacity that is double that of the 120 tonne crane. A crane with a bigger load moment is the bigger crane. The cranes, therefore, should not be compared by their hook load capacities only.

Normally breakdown cranes are classified into three categories:

1.	Small	Up to 700 tonne- metre load moment
2.	Medium	700 to 1000 tonne- metre load moment
3.	Large	above 1000 tonne- metre load moment

By this definition, the 140T Crane is a large Crane.



Railway Crane
General

140 Tonne B.D Crane is based on Hydraulic and pneumatic system. All the functions of this crane are accomplished with the help of either hydraulic circuit or pneumatic circuit or combination of these two circuits. Both the circuit comprise of hoses, pipes and other hydraulic & pneumatic components.

Various function of the crane requires different pressure. The pressure required is controlled with the help of pressure limiting valves which have been provided with manual pressure adjusting screws and measuring ports for fitment of gauges. Pressure gauge is fitted to measuring port and the required pressure is set by adjusting the screw.

The measuring ports of some pressure limiting valves are connected with their gauges fitted in operator's cabin. This enables the driver to keep a constant watch on operating pressure while operating the crane.

The measuring ports of other pressure limiting valves are connected with gauges to check and set the pressure whenever required.

Before despatch of the crane, all the functions are tested by setting the required pressure in the respective pressure limiting valves. A list of such valves and their detailed information are enclosed for the users in overcoming any problem which may arise during the operation.

LOCATION OF:

I) PLUGS FOR MEASURING CONNECTION
II) MANUAL ADJUSTMENT PROVISION FOR PRESSURE AND FLOW CONTROL

HYDRAULIC SYSTEM SUPERSTRUCTURE
DRG. NO. 3.1301.0141-0 SH1 & SH2

ITEM NO.	DESCRIPTION	PROVISION OF	NORMAL SETTING PRESSURE
10	Multi Spool Control Block MO30/4F	i) Manual Pressure Adjustment ii) Manual Pressure Adjustment Plug Connection Leading to Gauge fitted in Driver's Cab	280 bar- lifting 120 bar- lowering
11	Multi Spool Control Block SM 12/1F	i) Manual Pressure Adjustment ii) Manual Pressure Adjustment Plug Connection Leading to Gauge fitted in Driver's Cab	240 bar- lifting 30 bar- lowering
12	Multi Spool Control Block SM 12/2F	i) Manual Pressure Adjustment Plug for fitting Measuring connection	250 bar

ITEM NO.	DESCRIPTION	PROVISION OF	NORMAL SETTING PRESSURE
21	Pressure Limiting Valve Cartridge	i) Manual Pressure Adjustment ii) Manual Pressure Adjustment Plug for fitting measuring connection	60 bar- Oil Cooler 140 bar- Radiator
46	3 Way Flow Regulator	i) Manual Flow Adjustment Plug for fitting measuring connection	15 L/min
47	Pressure Limiting Valve Cartridge	i) Manual Pressure Adjustment Plug for fitting measuring connection	30 bar

LOCATION OF:

I) PLUGS FOR MEASURING CONNECTION
II) MANUAL ADJUSTMENT PROVISION FOR PRESSURE AND FLOW CONTROL

HYDRAULIC SYSTEM UNDERCARRIAGE
DRG. NO. 3.1402.0060-0

ITEM NO.	DESCRIPTION	PROVISION OF	NORMAL SETTING PRESSURE
7	Motor Protection Valve Block	i) Manual Pressure Adjustment Plug for fitting measuring connection	280 bar
9	Multi Spool Control Block SM 12/4F	i) Manual Pressure Adjustment Plug for fitting measuring connection	240 bar
18	Multi Spool Control Block SM 12/5F	i) Manual Pressure Adjustment Plug for fitting measuring connection	240 bar

HYDRAULIC HAND BRAKE (Crane nos. 142032-142043, 143001-143002)
DRG. NO. 3.1402.0060-1

ITEM NO.	DESCRIPTION	PROVISUION OF	NORMAL SETTING PRESSURE
9	Pressure Limiting Valve	i) Manual Pressure Adjustment Plug for fitting measuring connection	40 bar
10	Pressure Limiting Valve	i) Manual Pressure Adjustment Plug for fitting measuring connection	140 bar

Pressure Limiting Valves 2.7

LOCATION OF:

I) PLUGS FOR MEASURING CONNECTION
II) MANUAL ADJUSTMENT PROVISION FOR PRESSURE AND FLOW CONTROL

PNEUMATIC SYSTEM UNDERCARRIAGE
DRG. NO. 3.1402.0061-0

ITEM NO.	DESCRIPTION	PROVISION OF	NORMAL SETTING PRESSURE
31	Spill Valve	i) Manual Pressure Adjustment Plug for fitting measuring connection	6.5 bar
46	Pressure Controller	i) Manual Pressure Adjustment Plug for fitting measuring connection	5 bar

PNEUMATIC SYSTEM SUPERSTRUCTURE
DRG. NO. 3.1301..0143-2

ITEM NO.	DESCRIPTION	PROVISUION OF	NORMAL SETTING PRESSURE
12	Spill Valve	i) Manual Pressure Adjustment Plug for fitting measuring connection	5 bar
14	Pressure Regulator	i) Manual Pressure Adjustment Plug for fitting measuring connection	6.2 - 7.3 bar

Railway Crane
General

Definitions 2.8

P-1/1

- **NUMBER OF AXLES**

  The number of axles has an important bearing on the working of the crane. If the number of axles is kept large to stay within axles load limitation, it will result in an unduly long crane that may require extra time for attaching, detaching, preparation, etc. It is also likely to have lower running speeds. Cranes with a large number of axles usually have poor riding. It is, therefore, desirable to keep the number of axles as low as possible.

- **TAIL RADIUS**

  This is the maximum distance from the centre of rotation to the tail of the revolving superstructure. If the tail radius is small the crane will not get obstructed by the tail portion of its superstructure while working in cuttings, etc. However, a small tail radius will increase the need for more counter weights which may require an additional ballast wagon and consequently more setting up time.

- **PROP BASE**

  The effective span or area of the supporting base when outriggers are used to increase stability by virtue of making contact with the ground at points farther from the centre line of the crane than the normal wheels/track position, the size of this base is obviously very critical in the design of the crane. A small prop base is advantageous while working in cuttings while a large base is useful in embankments where the soil cannot take heavy loads.

- **BASIC CRANE MOTIONS**

  These are:

  Hoisting: The movement of the hook, main or auxiliary, with or without load, when being raised or lowered vertically with jib remaining stationary.

  Slewing: The movement of the superstructure along with jib rotating about a vertical axis.

  Derricking: Raising and lowering of Jib in a vertical plane.

  Traveling: This is the self travel of the crane.

- **WORKING RADIUS**

  The horizontal distance from the centre line of the load attached to the hook to the centre about which the crane slews.

- **OUTREACH**

  The horizontal distance from the centre of the lifting hook to the headstock (undercarriage)

- **STABILITY**

  Stability is based on the moments about the tipping fulcrum. The worst condition usually occurs when the jib is at right angles to the track. For a free on rail duty the fulcrum is the rails while for propped duty, the jack beam ends are the fulcrum. The sum of the moments in front of the fulcrum plus a percentage of the load for stability margin must be balanced by the sum of the moments behind the fulcrum. For this naturally the maximum load at the maximum radius is taken into consideration.

  A crane has to be stable backwards also. This introduces some problems as the weight in the tail used to counterbalance the weight in the jib and the hook load becomes an overturning moment for backward stability when the jib is raised to its minimum radius and consequently its weight only partially comes into play for forward moment.

Railway Crane
General

General Notes **3.**

Railway Crane
General

General Safety Instructions 3.1

P-1/4

THE SAFETY INSTRUCTIONS ARE ACCETUATED WITH A WARNING SYMBOL.

Special safety instructions have been indicated in advance of the specific instructions for maintenance work in this Maintenance Manual. These instructions are to be interpreted as a supplement and do not exclude the general safety instructions mentioned! Before any work is carried out on the electrical system, ensure that the system is not under power and, if applicable, the diesel engine must be switched off. It must be ensured that all the above equipment is safeguarded against re-starting. Should the power supply have to be established again for functional checks, ensure that the complete power supply is switched off again before work is resumed.

Prior to performing work on the air pressure or hydraulic system, ensure that these systems are not under pressure. Note that when work is carried out to the hydraulic system, the system is under pressure and the hydraulic oil is hot. When subjected to fire or naked light, hydraulic oil is inflammable. As the crane must be operational for pressure, temperature and leakage checks, there is a high degree of danger involved. During or after maintenance work on the crane, the pre-set hydraulic pressures must not be altered. Special qualified personnel and utmost care for this work are essential. Before maintenance work is started, ensure that the crane can not be switched on by the unauthorized persons.

CAUTION! CERTAIN PARTS OF THE SYSTEM ARE STILL UNDER PRESSURE EVEN WHEN THE CRANE IS AT A STANDSTILL!

ENSURE WITHOUT FAIL THAT WASTE OIL FROM THE HYDRAULIC SYSTEM, DIESEL ENGINE AND THE EMERGENCY DIESEL ENGINE AND THE CONDENSATION CONTAINING OIL FROM DE-AIRING AND CLEANING WORK ARE DISPOSED OF ACCORDING TO REGULATIONS.

Special caution is required when maintenance work is carried out on the diesel engine or the emergency diesel engine directly after operation. Engine oil, engine housing and exhaust system are still hot. As the crane must be operational for functional and sealing tests, there is an increased degree of danger as with the hydraulic system. When work to the diesel engine system is carried out, ensure without fail that unauthorized persons cannot start the engine. Ensure that ear protection is worn when maintenance work is carried out on the running diesel engine.

The diesel engine and the emergency diesel engine must not be operated in enclosed areas- Danger of intoxication through exhaust fumes!
No smoking, no naked flame or light, sparks or glowing ashes near the fuel or diesel engine system- Danger of explosion and fire!
It is forbidden to climb up onto the crane when the crane is in operation.

In addition, ensure that all respective statutory safety regulations are observed during all work! This applies, in particular, to tests on the tank and pipe systems.

Observe the information provided by the manufacturer for systems requiring monitoring during operation and maintenance work.

Railway Crane
General

Operating Personnel

A crane is a highly technical and sophisticated machine. Safe and competent operation requires a sense of responsibility and skill on the part of the crane operator. Likewise, he should be in good mental and physical condition to ensure completely safe operation.

Proper and Due Operation

The crane has been developed exclusively for crane work. This means that, for example, conveyance of loads or persons is not permissible in crane operation; only one person per seat may be conveyed with the crane.

Only lifting gear and accessories, which have been supplied or approved expressly by the crane manufacture, may be used. It is prohibited to use the crane for any other purpose other than for what it was designed for.

It is assumed that the ambient conditions for the work zone of the crane meets the requirements so that the information provided in "Technical Data" can be adhered to without any danger occurring.

Caution! - Please note the various lifting capacities for the individual modes of operation. These lifting capacities can be found in the section "Technical Data" and in the Lifting Capacity Charts.

Limit switches must not be bridged. Mean figures for outside temperature, air humidity and degree of dust have been used as a basis for these data. Should the figures be higher, the maintenance intervals must be stepped up accordingly.

Observe the information provided by the respective lifting gear manufacture!

Endeavor to reduce any remaining risks by applying any suitable measures at crane site.

Use of Skilled Personnel

Specially trained and initiated personnel may only carry out operation, maintenance, service and repairs. It must be ensured that the skilled personnel employed not only have the corresponding technical knowledge, but in addition are also informed about all relevant Safety instructions. Constant work during restoration by a single Operator for longer periods should be avoided.

STANDING IN THE SLEWING RANGE IS PROHIBITED. LIKEWISE UNAUTHORISED PERSIONS MUST NOT BE IN OR ON THE CRANE DURING OPERATION. LOADS MUST BE LIFTED PROPERLY, i.e. DIAGONAL PULL AND BREAKING LOOSE OF LOADS ARE PROHIBITED.

Railway Crane
General

Duties of the Crane operator

The crane operator has the following duties:

***** He must check whether the brakes and the emergency limit switches function prior to commencing work. He must watch the condition of the crane for any visible defects.

***** He must see to it and ensure that the power to the overhead lines is switched off prior to commencing work on the crane.

***** When he notices any defects, which could be dangerous for operating safety, he must stop crane operation.

***** He must report any defects on the crane to the supervisor responsible and to his replacement on shift change.

***** He must ensure that all the controls are brought into neutral or idling position prior to supplying power to the drive assemblies.

***** He must ensure that all the controls are brought into neutral or idling position and that the power is shut off prior to exiting the control stand.

***** He must ensure that the crane is parked safely according to regulations when crane operating and crane travel operation have been completed.

* He must ensure that all outriggers are secured and traveling gears are in disengaged condition.

The crane operator must provide warning signals, when required.

Loads or lifting gear must not be moved above persons during any crane motions.

The crane operator may only move loads attached manually when he has received a signal from the person attaching the load, or the hand signaler or the person nominated by the crane operating company. If signals must be used to communicate with the crane operator, these signals must be agree upon between the crane operator and the person responsible for the signals before the signals are applied.

As long as a load is suspended on the hook, the crane operator must keep his hands near the controls.

The emergency limit switches must not be activated intentionally during operation.

The crane operator must ensure that the entire door are closed and locked during travel.

Loadings

Cranes may not be subjected to stress beyond the respective highest permissible loading.

Work Performed with Several Cranes

If the working range of several cranes overlap, the crane operating company or his representative must laid down the work procedure beforehand and must ensure that the communication runs smoothly among the crane operators.

Entering and Exiting the Crane

It is prohibited to allow any unauthorized persons to enter in or on the crane or its working range.

Cranes, which are occupied by a crane operator, may not be entered and exited until permission has been received from the crane operator and the crane has come to a standstill.

Only authorized persons may move onto or off the footboards when the crane operator has been notified accordingly.

Conveyance of Persons

The conveyance of persons on the load or lifting gear is prohibited.

Ambient Conditions

Ensure as to whether the erection surface can withstand the required crane support pressures and the ground is suitable for working with the crane safely. Should the crane have to be traveled, the route must be checked beforehand. Please take into consideration clearance widths, heights and the crane weight.

Railway Crane
General

Legend for Notices and Prohibiting Signs **3.2**

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Keep out of the slewing range