

ROURKELA STEEL PLANT

A REPORT ON TOUR TO

BHILAI STEEL PLANT



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I am grateful to all executives, operators and other employees of different dept. working under operation and maintenance departments of Bhilai Steel Plant for sharing their valuable experience and knowledge with me.

Visit Programme

Date.	<u>Section</u>	Section Head
04.04.2022	Planning	Shri. A.K. Malla
04.04.2022	Mechanical Maint.	Shri. B.J.Babu
04.04.2022	Electrical Maint.	Shri. N.K.Sahoo
05.04.2022	Assembly Section	Shri. H.L.Sonwani
05.04.2022 Tool Room, H.T &		Shri. N.K.Sahu
	Store	
06.04.2022	Machining Section	Shri. R.S.Sindhu

INTRODUCTION

About Bhilai Steel Plant

Eleven times winner of Prime Minister's Trophy for Best Integrated Steel Plant in the country, Bhilai Steel Plant (BSP) is India's largest producer & supplier of world class rails for Indian Railways including world's longest 130 metre rails in single piece and 260 metre long rail welded panels, and a major producer of large variety of wide and heavy steel plates and structural steel. The plant also specializes in other products such as wire rods and merchant products. The entire range of TMT products (Bars & Rods) produced by the Plant is of earthquake-resistant grade and superior quality. The plant also produces heavy structurals including channels and beams.

Since BSP is accredited with ISO 9001:2000 Quality Management System Standard, all saleable products of Plant come under the ISO umbrella. The Plant's HR Deptt is also certified with ISO 9001:2000 QMS Standard. ISO:14001 has been awarded for Environment Management System in the Plant, Township and Dalli Mines. The Plant is accredited with SA: 8000 certification for social accountability and the OHSAS-18001 certification for Occupational Health & Safety. BSP has been certified with ISO 50001:2018 Energy Management System for the entire scope of "Integrated Steel making covering products". It is the only unit of SAIL that is certified for the entire scope of steel making and also includes MODEX units within the scope.

BSP has received Integrated Management System (IMS) Certificate by a single certifying agency (M/s DNV), integrating QMS, EMS, OHSAS & SAMS - becoming the first SAIL unit and among few corporate houses in India to achieve this

Known for their unique collaborative work culture and industrial harmony, Bhilaians have won many awards and accolades bringing pride and glory to Bhilai Steel Plant. Of the 19 individuals to have been awarded the Prime Minister's ShramRatna Award so far, 13 are employees of Bhilai Steel Plant. BSP has been also awarded CII-ITC sustainability Prize for three consecutive years, CREDA excellence Award in the category of Integrated Steel Plants at State Level Sustainable Energy Awards – 2016 and prestigious SCOPE Award for Best Practices in Human Resource Management. Recognizing BSP's contribution towards taking care of its senior citizen, BSP has achieved the rare distinction of winning VayoshresthaSamman which was accorded by Ministry of Social Justice. The production capacity of Hot Metal, Crude Steel & Saleable Steel after completion of Modernisation & Expansion Programme (MEP Plant/unit wise) is as under:

Hot Metal – 7.5 MT (Million Tonnes) Crude Steel – 7 MT Saleable Steel – 6.56 MT

Location : Forty kms west of Raipur, the capital city of Chhattisgarh, along the Howrah-Mumbai railway line and the Great-Eastern highway, stands Bhilai Steel Plant (BSP).

Main Technologies and Assets

BSP uses Blast Furnace technology for iron making and CCS route of steel making. The Plant produces continuously cast steel slabs, blooms and billets through Slab, Bloom & Billet Casters. The CONCAST route of steel making is also equipped with secondary refining units like Vacuum Arc Degassing (VAD), Ladle Furnace & RH Degasser to produce the clean steel. These cast products are rolled into long and flat products through Rolling Mills which include Rail and Structural Mill (RSM), Plate Mill (P Mill), Wire Rod Mill (WRM) and Merchant Mill (M Mill) that were established during the 1 to 4 MT stage.

The technology has been upgraded and updated with every modernization and expansion and also through continual assimilation of state of the art technology for product and process improvements. The Plant produces cleanest steel with Hydrogen in rail steel less than 1.6 ppm. World-class long rail manufacturing complex at RSM has sophisticated technologies viz. Online Eddy Current & Ultrasonic Testing Machines for Rails, Laser Straightness Measurement, Laser etc.

Plate Mill also has advanced facilities for ensuring high product quality such as – Online Ultrasonic Testing Machine, Hydraulic Automatic Gauge Control (HAGC), Plan View Rolling (PVR), Normalizing Furnaces, etc.

As part of the Plant's 7 MT Modernization & Expansion (MODEX) programme, cutting edge technologies for expanding product profile, improvement in productivity, yield, quality, cost competitiveness, energy efficiency and environmental protection have been installed. New Modex units include Blast Furnace No 8, Steel Melting Shop 3, Universal Rail Mill & Bar & Rod Mill.

Captive mines

Iron Ore - Dalli-Rajhara Iron Ore Complex (IOC), 80 kms from Bhilai. Rowghat Mining Project, situated 80 kms from Dalli-Rajhara IOC is being developed to meet future iron ore requirements of the Plant. Limestone – Nandini, 23 kms from Bhilai Dolomite - Hirri, 150 kms from Bhilai

Coke Ovens

- 8 Batteries of 4.3 metre height with 65 ovens each
- 3 batteries of 7 metre height with 67 ovens each

Sinter Plants

SP 2 – 3 machines of 75 sq metre hearth area & 1 machine of 80 sq metre hearth area

SP 3 – 1 machine of 320 sq metre hearth area & 1 machine of 360 sq metre hearth area

Blast Furnaces

- 1 Blast furnaces of 1033 cu.m useful volume
- 3 Blast furnaces each of 1719 cu.m useful volume
- 1 Blast furnace of 2355cu.m useful volume
- 1 Blast furnace of 4060 cu.m useful volume

Steel Melting Shop 2

Steel-making through BOF, VAD/Ladle Furnace/RH-Degasser and Continuous casting route

Converter Shop :

- 3 converters of 110/130 T
- Secondary Refining facilities : VAD unit, 2 nos of RH degasser,2 nos of Ladle furnace, 1 Desulphurisation Unit
- 4 Slab Casters, 1 bloom caster, 1 Combi caster

Continuous Slab Casting Shop: 4 Casters. 1bloom caster. 1Combi Steel Melting 3caster Shop Steel-making through BOF, Ladle Furnace/RH-Degasser and Continuous casting route

SMS-3

Consistsof3maintechnologicalpackages

- 1. Basic Oxygen Furnace
- 2. Continuous Casting Plant
- 3. Secondary Refining Unit

SMS 3 has three Convertors of 180 Tonne capacity, and 3 Casters in operation, including 2 Billet Casters and 1 Bloom Caster. The Secondary Refining Units comprise of Ladle Furnace, RH Degasser and Argon Rinsing Station.

Rail & Structural Mill

Products

• Rails - R52 Kg/m & R60 Kg/m ; UTS 880 N/mm2 rails as per IRST-12/96 specifications, Euronorms and international standards.

• New Grade & Profile - R260/60E1 is now being rolled & supplied to Indian Railways.

- Thick web asymmetric rail Zu 1-60
- Beams 600,500,450,400,350,300 & 250.
- Channels 400,300 & 250.
- Angles 200 & 150.
- Crossing Sleeper.
- Crane Rails KP80, 100,120 & 140.

Merchant Mill

Products

- Plain Rounds : dia 28, 32, 36,40, 50,53, 56, 63 & 67
- TMT Bars : 25,28, 32, 36, 40 & 45
- Lt. Structurals :Channel 100 x 50, 75 x 40
- Angles : 50 x 50 x 5 upwards to 90 x 90 x 10

Customised product campaigns are being taken up for shorter durations in case of light structurals and rounds for compliance of smaller quantity orders as per committed delivery within the month.

Wire Rod Mill

Plain Wire Rods in 5.5, 6, 7 and 8 mm. TMT : 8, 10, and 12 mm

Plate Mill Plates thickness - 8-120 mm

Width- 1500-3270 mm Length - 5-12.5 M

The Plate Mill rolls out heavy and medium plates, as well as those for pipe manufacturers. Plates of wide variety, in any required size, and strength, chemical and physical properties, can be produced here. It has capacity to produce high pressure, boiler quality and high tensile steels. Some of the unique features of the mill are on-line finishing facilities and off-line normalising facilities. Bhilai has one of the widest plate mills in the country, and it uses continuously cast slabs as input. Liquid steel produced under controlled conditions in the LD Converters is rinsed with argon gas to homogenise

the composition as well as to remove non-metallic inclusions before continuous casting so as to ensure the production of high quality feedstock for the Plate Mill. As per customers' requirement or specifications, plates are normalised in a roller hearth normalising furnace.

AUXILLARY UNITS –

Two Power Plants – Two Captive Power & Blowing Stations. In addition, Power Plant 2 locate inside BSP is in joint venture with NTPC (NSPCL). Power also being drawn from another joint venture power plant PP 3.

Oxygen Plants- Two including one captive Oxygen Plant (OP 2) and one BOO Plant run by Praxair. Refractory Materials Plants – Two RMPs for production of calcined dolomite & lime

Foundry & Engg Shops for captive manufacture of spares, assemblies, mould and forging

Coal Chemicals units for recovery of various coal chemicals / by products from coal carbonization

NEW FACILITIES ADDED AS PART OF 7 MT MODERNISATION & EXPANSION:

As part of the Plant's 7 MT Modernization & Expansion (MODEX) programme, cutting edge technologies for improvement in productivity, yield, quality, cost competitiveness, energy efficiency and environmental protection have been installed.

A snapshot of BSP's Modex facilities is placed below:

2.8 MTPA BLAST FURNACE 8 -

Named Mahamaya, the new blast furnace with modern design has a useful volume of 4060 cubic metre and capacity of producing 8030 tonnes of hot metal per day and 2.8 million tones perannum. Blast Furnace 8 has various new generation technological features like cast house and stock house dedusting system, top pressure recovery turbine (TRT), pulverised coal injection (PCI), modern Heat transmission System through carbon block, ceramic cup and SGI & Cu-staves and other state of the art energy-efficient and pollution control equipment including Waste Heat Recovery system.

4 MTPA STEEL MELTING SHOP 3 -

The new and modern SMS III with state of the art technology consists of 3 main technologicalpackages-

- 1. Basic Oxygen Furnace (BOF)
- 2. Continuous Casting Plant
- 3. Secondary Refining Unit

SMS 3 has three Convertors of 180 Tonne capacity and 3 Casters in operation, including 2 Billet Casters and 1 Bloom Caster. The Secondary Refining Units comprise of Ladle Furnace, RH Degasser and Argon Rinsing Station.

Process : Hot metal from Blast Furnace 8 is transported in Torpedo Ladles to Hot Metal Handling Area of SMS 3 where it is poured into Hot Metal Ladle of SMS 3. The Hot Metal ladle is then lifted with the help of 300 Tonne capacity cranes of SMS 3.

Hot metal is processed and converted to crude steel in 180 Tonne capacity Convertors. Subsequently, secondary refining and altering of chemistry of crude steel as per requirement of end use of steel is done in Ladle Furnace and RH Degasser. The crude steel thus processed is then cast into billets and blooms in different casters of SMS 3.

1.2 MTPA Universal Rail Mill -

The 1.2 MTPA Universal Rail Mill that has state of the art technologies for universal rolling, finishing & testing, would help SAIL to meet the increased demand for 260 metre rails from the Indian Railways, as also other grades as head-hardened rails to meet requirement for high-speed rail transport and freight corridors.

Universal Rail Mill produces and supplies rails in rolled lengths upto 130 metre - the world's longest rail in single piece to Indian Railways, and welded panels upto 260 metre. A new grade of rails – R260 with new profile 60E1 developed recently is now being rolled out and supplied to Indian Railways as per the

requirement. Besides, the new Mill is also being equipped with online head hardening facility to meet the Railway's requirement of head hardened rails.

0.9 MTPA Bar & Rod Mill -

The Bar & Rod Mill is equipped to produce a wide range of products including Wire rod in Coil, TMT Rebar in Coil, TMT Rebar Straight and Quality Bar in Straight length in diameter ranging from 5.5 mm to 60 mm.

The special grade steels that would be rolled in the new mill include Low, Medium & High Carbon Steel, Spring Steel, Bearing, Low Alloy, Free Cutting & Welding etc. will help SAIL and BSP sustain leadership in the highly competitive market for steel used in construction and infrastructure sector. Besides the wide product range (5.5 mm to 60 mm) and Flexibility of product mix (Wire Rod, TMT Bar, Quality Bar), the new Mill ensures high quality of final products, including SAIL Secure grade of products.

The new mill is equipped with Fully Automatic Digital type walking beam furnace. The high speed of rolling and Ready to Roll concept also ensures high productivity.

The user-friendly automation system ensures minimisation of Operating Personnel. The compact Design of the mill and optimisation of input material temperature also results in substantial Energy Savings.

Refractory Materials Plant 3 –

Refractory Materials Plant 3 has five kilns for production of lime and calcined dolomite – each of 450 tonnes/day capacity. A fully automated plant with computerized operations, the new plant is equipped with dedusting system, gas cleaning plant and dust suction facilities, making it an environment friendly unit. The kilns are gas fired as against the conventional oil-fired system, making it energy efficient as well.

OTHER MODEX UNITS –

- New 7 M tall Coke Oven Battery No. 11
- Additional sinter machine in existing Sinter Plant No. 3 of 360 sq.m.

BHILAI STEEL PLANT PRODUCTION FACILITIES AT A GLANCE Coke Ovens Batteries: 11 Nos.

- 8 batteries of 4.3m height consisting of 65 ovens each
- 3 batteries of 7m height consisting of 67 oven each (COB-11: MODEX unit) Blast Furnaces : 6 Nos.
- 1 Blast furnaces of 1033 cu.m useful volume
- 3 Blast furnaces each of 1719 cu.m useful volume
- 1 Blast furnace of 2355cu.m useful volume
- 1 Blast furnace of 4060 cu.m useful volume(BF-8 : MODEX Unit)

Sintering Plants : 2 Nos. • SP-2 : 3x75sq.m hearth area and1x80sq.m hearth area

• SP-3 : 1x320sq.m hearth area and 1x360 sq.m hearth area (M/c-2 : MODEX unit)

Steel Melting Shop-2 Steel Melting Shop-3

Convertor Shop :

- 3 Converters
- Hot Metal Desulphurisation Unit
- Secondary Refining facilities : VAD, RH Degasser & Ladle Furnaces
- 4 Slab Casters, 1 bloom caster, 1 Combi caster
- 3 Convertors
- Hot Metal Desulphurisation Unit (under advance stage of commissioning)
- Secondary Refining Facilities RH Degasser & Ladle Furnace
- CCS : 3 Casters (2 billet & 1 Bloom Caster) in operation

Mills

- Rail & Structural Mill
- Modex Unit 1.2 MTPA Universal Rail Mill
- Plate Mill
- Merchant Mill
- Wire Rod Mill
- MODEX Unit 0.9 MTPA Bar & Rod Mill

Auxiliary Units

• Two Power Plants – one captive and other in joint venture with 104MW total power generation capacity.

- Two Oxygen Plants including one BOO Plant
- Refractory Materials Plants, including MODEX unit RMP 3
- Foundry & Engg. Shops
- Shops Coal Chemicals units
- Slag granulation plants

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Mills	 Rail & Structural Mill Modex Unit - 1.2 MTPA Universal Rail Mill Plate Mill Merchant Mill Wire Rod Mill MODEX Unit - 0.9 MTPA Bar & Rod Mill 	
Auxiliary Units	 Two Power Plants – one captive and other in joint venture with 104MW total power generation capacity. Two Oxygen Plants including one BOO Plant Refractory Materials Plants, including MODEX unit 	

BHILAI STEEL PLANT PRODUCTION FACILITIES AT A GLANCE

RMP 3

- Foundry & Engg. Shops
- Shops Coal Chemicals units
- Slag granulation plants

ACHININGASSEMBLY&RE-ENGINEERINGSERVICES-1(MARS-1)

MARS-1 has a vital role to play in maintaining the plant equipment so for as it supplies the bulk of spare parts& sub assemblies required by the various units. It acquires an added significance by virtue of the finishing line of manufacturing activities of engineering shop. The product mix so arranged so as to meet the demand of both heavy and small spares. The shop is housed in three machining bays, 21 meters x182 meters each with an assembly bay of 24 meters x 96meters. A total of 134 machine –tools are engaged in direct production of spares, where-as the remaining contribute indirectly towards shop production. Apart from these, there are 12 Heat Treatment /Heating furnaces 22 material handling equipment (cranes, jib cranes transfer cars).

MAJOR ACTIVITIES:- FunctionwiseMARS-1 carries out the following activities:

- Manufacture of spares, changeable, tools, tackles etc. Required for maintenance and operation of various departments.
- OverhaulingandrepairofequipmentsubassembliestotheextentofthosethatcanbetransportedtoMARS-1.
- 3. Reclamation of worn-out spares.
- 4. Repairofcertainequipmentatsiteespeciallywheremachiningatsiteisrequired.
- 5. Manufacturing and modification of equipment / spares for development work from the point of view of import substitution, cost reduction, etc.

FLOWPROCESS:-

A brief description of process for spares manufacture from the orders given below:-

Production order for a group of jobs is placed on the shop by the central planning department (CPD) through ERP. The CPD prepares a monthly plan ,Capital repair plan & priority job plan ,enlisting the

jobs to be carried out in a particular month , after necessary discussion ,review of previous month's plan , requirement of new item etc; with the help of shop planning section and ordering departments. Jobs are categorized in the order of priorities.

This plan is processed for execution by the shop planning section. The technology prepares calculations, tooling is prepared in advance by tool room . These master cards are numbered and stored by planning section for future reference, and copies made out for execution taking into account priorities if any, blank availability etc. Simultaneously the blanks (forgings, castings or fabrications) stored in an open gantry storage (controlled by CPD) are taken in and after preparatory work, if any ,are supplied to the concerned machines . The route card, drawing and job card are issued to the machine when the job is taken up . After completion, inspection is carried out by the inspection department for quality control. The completed jobs are collected by the ordering department.

1. MachiningSection:-

The machining section carries out the following function:-

- (i) Manufacture of various spares of a wide variety, out of forged, casting and fabricated blanks.
- (ii) Finishing of reclaimed parts.
- (iii) Modification of various spares by machining.

For performing the above, apart from the general purpose machine tool ranging from extra heavy duty to light duty nature are used which are:

a)) Lathes		(Maxdia-2000mm,length12000mm)-	
	38no	DS		
	b)	Shapers	(Maxstroke1000mm)-1no	
	c)	PlanningM/cs	(Maxtablesize6000x2000mm)-	
		3nos		
	d)	Slotter	(Maxstroke1000mm)-4nos	
	e)	VerticalBoringM/cs	s (Maxdia-5000mm)-2nos	
	f) Pillar&RadialDrillingM/cs (Maxdrillsize80mm)-10nos			
	g)	HorizontalboringM	/cs (Maxspindledia175mm)-9nos	
	h)	PlanomillingM/cs	(Maxtablesize6300x2000mm)-	
		5nos		

The section is provided with a versatile gear cutting group comprising Gear Hobblers (max.Module36,dia3000mm), gear slotter(max,module8,dia500), a MAAG Gear shapers with rack unit (Maxmodule15,dia1450), straight cutting level gear (Max.Module24), and spiral bevel generators a gear generators(Max.Module1, dia 500). Other machines of special interest are a ROD Threading Machine and vertical Boring machine with copying attachment

The section is housed in three bays Heavy Machine Bay, Light& Medium Machine Bay and Expansion Bay. Handling equipments are provided in all the three bays which include 8 EOT cranes(Max. Capacity 30T/5T), 6 Electrical transfer cars (Max.Capacity20T) connecting the three bay to assembly section. Trolleys of 2T capacity are also provided for material transfer, stores collection etc.

2. PlanningSection

Guided by the monthly plan given by CPD, the shop planning section proceeds with various steps in processing the jobs. The functions of planning section are:

- 1. Receipt , document and storage of work- orders received and master cards department-wise.
- Collection preparation of finished products . A sub section called production control group (PCG) executes these jobs.
- 3. Scheduling of jobs operation-wise with a view to take up the various work on different machines as per sequence of operation specified , and to distribute the work load on machine in optimum manner.
- 4. Issue and receipt of jobs cards for each operation.
- 5. Assessment of progress of jobs, maintaining statistics of production and other relevant data.
- 6. Advance preparation of co-ordination with tool room.
- 7. Co-ordination with CPD and maintenance/ planning section of various ordering department for assemblies etc. The section has been provided with PCs for storage of master card and copies preparation.

The preparation of blanks machining includes and cutting of shafts, riser cutting on casting, marking out jobs etc. For these P.C.G. Is provided with 4 circular saw machining and 2 power back saws

3. TechnologySection:-

The section is responsible for working out the technological processing of jobs to be manufactured. The responsibilities of the section are.

- 1. Preparation of master card, detailing sequence of operations, type of machine tool to be employed, sequence of machining on each machine, cutting tools to be used necessary shop calculations, tooling required etc. Along with all other relevant and special instruction.
- 2. Design, manufacture in co- ordination with tool room and try out of jigs and fixtures where-ever applicable.

4. AssemblySection:-

- 1. Planned manufacture of new assemblies i.e. Crane wheels of various types and size for different department. Hammer crusher rotors for coke oven and sintering plant, Asslembly of various reducer of sms3,sms-II,etc.Asslembly of various roller of BRM,URM,PM etc. Assembly of URM composite roll ring with arbour.
- 2. Planned periodical repair/overhauling of equipment like B.F.Top equipments (charge distributor,bells,hoppersetc.), mud gun, exhauster of sp-II crusher roters for coke ovens, various transmission shafts.
- 3. Repairs / re- conditioning of parts / equipment of various department during scheduled repairs, capital repair or at the time of break downs.
- 4. Repair of babbitt bearings for various shops.

The assembly work involves extensive material handling for which three E.O.T.Cranes (max.Capacity50/10ton), one 3 ton mechanincal chain block & job crane is provided . Railway wagons can enter in to assembly bay at one end, enabling heavy assemblies to be brought in . Dismantling and assembly work are done with the help of two horizontal hydraulic presses (max.Cap 630tons) & hydraulic jacks up to 200 tons capacity. A gas fired furnace for heating of components fors hrunk fitted assemblies

(5) ToolRoom&TreatmentSection:-

The Tool Room is intended to

- i. Produce & Recondition various metal cutting tools & cutters
- ii. Repair measuring instruments / tools, hand tools etc.
- iii. Manufacture jigs, fixtures, gauges, templates, and special cutters.
- iv. Manufacture of machine tool accessories, and various other tackles.
- v. Manufacture precision jobs where high accuracy is demanded.

Also, tool room controls all the grinding operations carried out on various jobs produced in MARS-1.

To perform above functions addition to general purpose machine tools, tool room is equipped with a relieving lathe, a jig boring m/c with location accuracy of one micron pantograph engraving m/c, cylindrical & surface grinding machine of various capacities, tool & cutter grinders & hob grinding machine (to grind up tomodule36), a drill grinding m/c and a circular saw grinder.

Proper heat treatment of spares is an absolute for improving their performance and life. The heat treatment section is set up to effect this and is equipped to carry out general heattreatment process like hardening and tempering for increasing hardness or improving structural and mechanical properties, normalizing for relieving tresses induced in forging etc, annealing to improve machinability . Facility exist for case hardening. Equipments installed are gas fired annealing furnaces, brazing furnace for brazing tools, electrically heated annealling of gears, gears shafts, crane wheels etc. And a high frequency induction heating brazing of carbide tipped tool are also available. An auto welding machine installed in heavy bay does the reclamation of worn out crane wheels, shafts etc, using submerged arc welding. A sorbitising m/c for surface hardening is also provided. A forging section is also provided with a gas fired heating furnace and a pneumatic hammer, for forging of tools & tools hanks.

6. MaintenanceSection

The up keep & maintenance of machine tools and all other installations of MARS-1 is as vital to the shop performance as the production itself. This is carried out by Electrical & mechanical maintenance section which have the following responsibilities. Regular checkup of condition of machine tools.

- i. Planned preventive maint. Of machine tools, with the objective of minimizing break downs by rectifying possible defect in advance.
- ii. Attending day today minor breakdowns.
- iii. Attending to major break downs in such way so as to curtail the downtime of machines to minimum.

7. StoreSection

Controlled by the Incharge tool room, this section ensures the supply of tool items & consumable required by MARS-1. These are normally collected from various centralized store of plant & kept as per requirement. This section is also responsible for procurement of all items specially required by MARS-1.

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