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Rev. 00

QUALITY ASSURANCE PLAN
BORE WEAR REDUCING LINER (BWRL)
FOR
155 mm BMCS M92 HZ

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RECORDS OF AMENDMENTS

Sl. No.	Amendment No.	Date of Amendment	Pertaining to Sl. No. /Clause No. /Para No.	Amended By Name & designation	Signature and Date

CONTENTS

1.0 GENERAL

1.1 QAP has been prepared by Standard Cell, OFN on the authority of The CGM, OFN, a unit of MIL, under Ministry of Defence, Govt. of India.

1.2 The information contained herein is privileged and should be used by authorized Personnel only.

1.3 The purpose of the QAP is to ensure the quality of BWRL and its raw materials, satisfy contractual agreements and meet quality standards.

1.4 This QAP is applicable and specific to manufacturing of BWRL.

1.5 The CGM,OFN or his authorized representative must have free access to the Suppliers/Manufacturers work premises, his processing facilities, assembly lines, Testing fields at all times during the auditing/ PDI as well as run of the contract. The supplier/manufacturer shall also make arrangements with outside agencies wherever becomes imperative to execute the Special Quality Management Tools / Tests with information to The CGM, OFN for effective and meaningful auditing as per IS/ ISO 19011: 2018 standard.

1.6 DEFINITIONS FOR TERMS AND ACRONYMS

ANSI	-	American National Standards Institute
AQL	-	Acceptable Quality Level
BMCS	-	Bi Modular Charge System
BWRL	-	Bore Wear Reducing Liner
CGM	-	Chief General Manager
DCL	-	Defect Classification List
DRG.	-	Drawing
DPSU	-	Defence Public Sector Unit
HZ	-	High Zone
IS	-	Indian Standard
ISO	-	International Organization for Standardization
MIL	-	Munitions India Limited
mm	-	Millimeter
NABL	-	National Accreditation Board for Testing and Calibration laboratories
OFN	-	Ordnance Factory Nalanda
PDI	-	Pre Dispatch Inspection
QC	-	Quality Control
QAP	-	Quality Assurance Plan
RMC	-	Raw Material Clearance
Sl. No.	-	Serial Number
Spec.	-	Specification
STEC	-	Storage and Transportation of Explosive Committee
w.r.t	-	with respect to

2.0 BRIEF DESCRIPTION OF THE PRODUCT

BWRL is being used as a barrel wear reducer resulting from firing of 155 mm BMCS M92 HZ Ammunition.

3.0 SAFETY/ SECURITY ASPECT

BWRL is a non explosive component. Hence no special safety regulation prescribed in STEC Pamphlet No. 2 is applicable to it.

4.0 TECHNICAL SPECIFICATION

BWRL shall be manufactured in accordance with the relevant drawings and relevant process schedule and shall meet all the technical requirements of the spec.

5.0 MARKING / IDENTIFICATION DETAILS AND LOT NO.

BWRL are to be marked / identified as per the relevant drg. /spec. Any changes required shall be subject to approval of The CGM, OFN and shall not be changed without approval.
However the supplier / manufacturer shall mention lot no. in every consignment at their end w.r.t Lot Size as mentioned below at Para.9.5.2.

6.0 QUALITY

6.1 ORGANISATION

The supplier / manufacturer shall have an appropriate organizational chart for the QC program describing the tasks in terms of QC activities, the roles and responsibilities of QC personnel performing the QC tasks to ensure that the concepts & standards applied are implemented and all testing & evaluation are done in accordance with approved plans, drawings, Standards and procedures.

6.2 FACILITIES

6.2.1 The supplier / manufacturer shall establish and maintain appropriate facilities for manufacturing of BWRL. The Shops used for manufacturing of BWRL shall be provided with all the necessary equipment/instruments, skilled personnel and appropriate environmental conditions with means of regulating temperature and relative humidity. The shops shall have a program for scheduled maintenance of all the equipment/test equipment/instruments. The shop shall maintain records of environmental conditions where required.

6.2.2 The supplier/manufacturer shall have/ arrange laboratory facilities for testing of BWRL. The laboratory shall be furnished with all the relevant test equipment/instruments and shall have a Program for scheduled maintenance of the test/measuring equipment/instruments. The laboratory shall have a program for calibration of its test/measuring instruments/equipment.

6.3 RAW MATERIALS / INPUTS

6.3.1 The supplier/ manufacturer shall offer all the raw materials as required for manufacturing of BWRL for sampling to the CGM, OFN or his authorized representatives in the format as per Annexure 'A' on supplier's / manufacturer 's letter head.

6.3.2 The CGM, OFN reserves the right to draw sample of raw material at firm premises for further testing or alternatively the CGM, OFN may instruct firm to draw sample on their own and submit to laboratory for testing of physical as well as chemical parameters as per spec. Here in both cases the supplier/ manufacturer shall submit Ordnance Factory/ DGQA/ Govt./DRDO/NABL accredited Lab test report after testing. Stores shall be manufactured only after getting RMC from OFN.

6.3.3 The laboratory test report must contain the following information-

i. OFN supply order no. & date
ii. Relevant specification no. and test method
iii. Date of sample receipt
iv. Date of testing
v. Representing bulk Lot quantity

6.3.4 After receipt of laboratory test reports of all raw materials to be used in manufacturing of BWRL from Ordnance Factory/ DGQA/ Govt./DRDO/NABL accredited Lab, OFN will examine the test reports and give RMC to the supplier/manufacturer for starting production of BWRL.

6.3.5 The supplier/ manufacturer should make effort to submit all the raw material against the SO at one go.

6.4 INTERMEDIATE

The Supplier/ manufacturer shall carry out inspection of all intermediates to ensure that they conform to the relevant spec. / drg. / standard. Only those intermediates meeting the spec. / standard /drg. shall be used for further processing.

6.5 PROCESS

The supplier/manufacturer shall ensure that only approved processes are adopted in the manufacturing of BWRL. The supplier/ manufacturer shall monitor and control the processes throughout the manufacturing process and shall maintain records of all critical process parameters. These records shall be made available to the CGM, OFN as and when required.

6.6 ACCEPTANCE / PERFORMANCE TESTS

The supplier/ manufacturer shall evaluate the lots of the finished BWRL and assure himself that the lots shall satisfy the requirements laid down in the relevant drawings/ spec. The number of samples to be drawn and the method of sampling shall be in accordance with the relevant standard/specification. Records of evaluation done on the lots shall be maintained and made available to the CGM, OFN as and when required.

7.0 PROCESS AUDIT

7.1 The CGM, OFN or his authorized Representative may conduct process audit in accordance with IS/ISO 19011:2018. The supplier/ manufacturer shall offer his premises to the CGM, OFN, free of cost, all reasonable / related facilities (including test equipment / gauges) for satisfying himself during process audit, that the stores are being manufactured in accordance with the governing specifications / Environment.

7.2 The CGM, OFN shall forward the audit report to the Supplier/ manufacturer for necessary corrective action. The process audit report shall indicate either conformity or non-conformity with audit criteria and whether the process is effective /efficient and identify opportunities for improvement. The overall objective of the audit is continual improvement. The Supplier / manufacturer shall identify corrective action and implement the same. A follow up audit may be planned and conducted by the CGM, OFN to assess the effectiveness of the corrective actions.

8.0 QUALITY AUDIT

8.1 AUDIT METHODLOGY AND PRINCIPLES

The CGM, OFN shall carry out Quality Audit in accordance with IS/ISO 19011:2018.

8.2 SAMPLING PLAN

8.2.1 The CGM, OFN or his authorized Representative shall inspect/ audit the bulk lot as per approved Sampling Plan ANSI/ASQ Z1.4-2003 (R 2018), Single sampling plan, Normal inspection, and General Inspection level-II or as per requirement of the CGM, OFN during PDI or receipt inspection at OFN. These samples should be thoroughly representative of the bulk.

8.3 PRE DISPATCH INSPECTION

8.3.1 Upon completion of the manufacturing of the bulk lot, the supplier/ manufacturer shall offer the bulk lot of BWRL to the CGM, OFN, free of cost, all reasonable / related facilities (including test equipment / gauges) for PDI along with following documents.

a. Pre inspection and in-process inspection reports of BWRL as per relevant drawing and specification.
b. Raw material consumption and balance statement as per Annexure-'C' on supplier's / manufacturer's letter head.
c. Safety certificate and guarantee/warranty certificates for every consignment as per Annexure-'B' on supplier's / manufacturer's letter head.
d. Any other quality related documents at the discretion of the CGM, OFN or his authorized Representative, as per general industry practice.

8.3.2 The CGM, OFN or his authorised representative shall audit the quality documents and draw samples from the bulk lot as per sampling plan, evaluate physical parameters as per approved drawing and Spec. and classify the samples as defective/non defective as per DCL based on physical inspection.

8.3.3 The CGM, OFN or his authorised representative shall draw samples, wherever required, for testing of physical and chemical parameters as per spec. to any Ordnance Factory/ DGQA/ Govt./DRDO/NABL accredited Lab.

8.3.4 Upon successful completion of PDI and satisfactory laboratory test results of BWRL, the bulk lot shall be recommended for Dispatch Clearance from OFN. Lots not meeting the criteria for acceptance requirement during PDI or unsatisfactory laboratory test results the lot shall be **REJECTED**.

8.3.5 The CGM, OFN in his discretion may exempt the PDI and allow consignment to dispatch without PDI. In that case the lot will be accepted/ rejected based on receipt inspection of the bulk lot at OFN.

8.4 RECEIPT INSPECTION

8.4.1 Upon receipt of the bulk lot at OFN, QC team of OFN shall audit the quality documents and draw samples from the bulk lot as per sampling plan, evaluate physical parameters as per approved drawing and Spec. and classify the samples as defective/non defective as per DCL based on physical inspection. The supplier/ manufacturer shall submit following documents along with consignment-

a. Pre inspection and in-process inspection reports of BWRL as per relevant drawing and specification.
b. Raw material consumption and balance statement as per Annexure-'C' on supplier's / manufacturer's letter head.
c. Safety certificate and guarantee/warranty certificates for every consignment as per Annexure-'B' on supplier's / manufacturer's letter head.
d. Any other quality related documents at the discretion of the CGM, OFN or his authorized Representative, as per general industry practice.

8.4.2 Additional samples may also be drawn from the bulk lot by OFN QC team for testing of physical as well as chemical parameters at any Ordnance Factory/ DGQA/ Govt./DRDO/NABL accredited Lab. Sample will also be sent to user section for user trial.

8.4.3 In case where PDI has been done, the scope of receipt inspection will be in the preview of the CGM.

8.4.4 Upon successful completion of receipt inspection, auditing of quality documents provided by the supplier / manufacturer, satisfactory laboratory test results and user trial report, the bulk lot shall be sentenced as **ACCEPTED**. Lots not meeting the criteria for acceptance requirement or unsatisfactory laboratory test results or adverse user trial report, the lot shall be sentenced as **REJECTED**.

9.0 ATTRIBUTED INSPECTION PLAN

Normal inspection- Single Sampling Plan- General Inspection level II

Lot Size : 10800 nos. or multiple of 10800 nos.

Sample Size : As per Sampling Plan no. ANSI/ASQ Z1.4-2003 (R 2018)

DCL	AQL%	Accept	Reject
Critical	0.04	As per Sampling Plan no. ANSI/ASQ Z1.4-2003 (R 2018)	
Major	0.65		
Minor	1.50		

9.1 DEFECT CLASSIFICATION LIST (DCL):

Sl.	Inspection Parameter	Specified Limit	Nature of defect	DCL
01	Weight	As per Drg./Spec.	Weight of BWRL beyond specified limit.	Major
02	Physical Dimensions		Dimension of BWRL beyond specified limit.	Major
03	External Defects	---	Cracks, Scales and voids and non-uniformed wax layers on BWRL	Minor
04	Chemical/Physical parameters	As per Spec.	Chemical/physical parameters beyond specified limit.	Critical

10.0 PROCEDURE FOR DISPOSAL OF NON-CONFORMING MATERIAL

BWRL not meeting the standard/specifications during bulk receipt inspection at OFN shall be sentenced as '**REJECTED**' and intimated to the supplier/ manufacturer for collection from OFN Store. Further action will be taken as per procedure laid down in Supply Order.

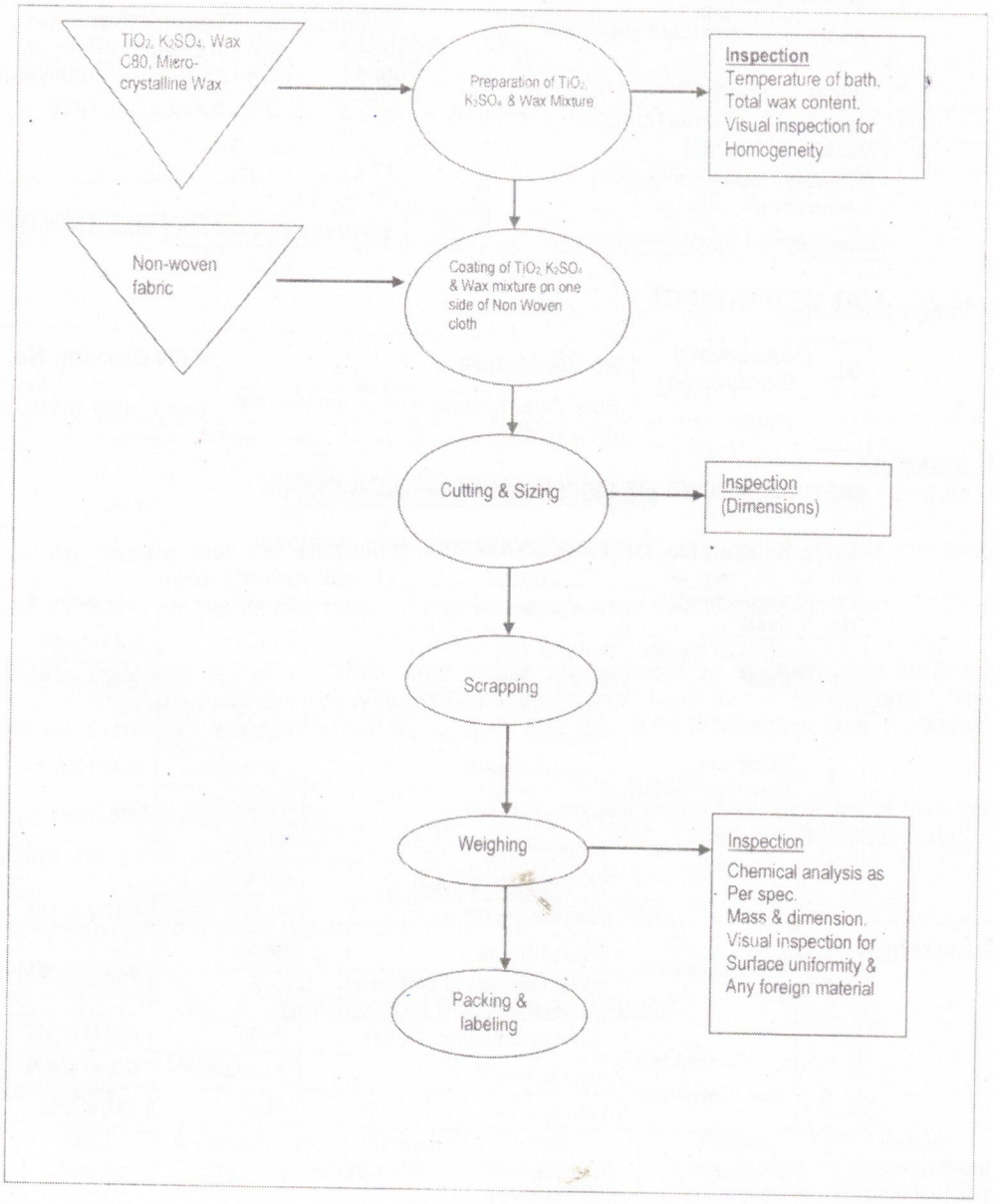
11.0 PROCESS SCHEDULE FOR MANUFACTURING OF BWRL

Process Schedule No. OFN/PS/M92/BWRL/00

Sl.	Process	Process Description	Checkpoint
1	Preparation of wax, Potassium Sulphate (K_2SO_4) & TiO_2 (Titanium Di oxide) mixture	TiO_2 and K_2SO_4 are to be added to the molten mixture of wax as per following scheme and thorough mixing in a mixer with hot water circulation or water bath. TiO_2 : 50 ± 2% C 80 - wax : 25 ± 2% Wicéra GZ micro wax : 8 ± 2% K_2SO_4 :17 ± 2%	• Temperature of bath 70°C-80°C. • Total wax content 31-35 %. • Visual inspection for Homogeneity.
2	Coating of TiO_2-Wax mixture on non-woven cloth	Hot mixture of TiO_2 -K_2SO_4-wax mixture is to be coated uniformly by rolling m/c on one side of non-woven fabric cloth.	• Visual inspection of non-woven cloth – should be free from foreign particle and should not be torn. • Wt. distribution shall be of 54 g/m^2 ± 12% to form a smooth, hard layer, free from ridges & protrusions.
3	Rolling	Coated cloth is passed through a roller, to ensure uniform spread and thickness and allowed to cool.	---
4	Cutting & sizing	Final cutting and sizing are to be carried out as per following dimensions Length : 458 ± 2 mm Width : 90 ± 2 mm	Dimensions
5	Scraping	Sized BWRL may be scraped to obtain required weight (Wt. of BWRL : 38-42g)	• Weight. • Ensure free from cracks, scales and voids. • Surface should be uniform all over and edges are free from burrs.
6	Inspection, Sampling & Packing	BWRL are to be wrapped in laminated paper and such packets are packed in cardboard box.	• Chemical analysis as per specification. • Physical inspection: Mass & dimension. • Visual inspection: Surface uniformity. • Any foreign material
7	Storage & Issue	Store at magazine & finally issue to consignee.	---

12.0 PROCESS FLOW CHART FOR MANUFACTURING OF BWRL

Process Flow Chart No. OFN/ PF/M92/BWRL/00



13.0 INPUT MATERIAL SPECIFICATION OF BWRL:

13.1 SPECIFICATION

Specification No. OFN/SPEC/BMCS/M92/BWRL/00

Chemical & Physical Properties	Composition (in %)	Test Methods As per
Titanium Dioxide (Rutile) (TiO_2)	50 ± 2	OFN/QC(LAB)/BWRL/009 dated 22.11.2017
Total Wax [C80 Wax (25±2%) + Wicera ZG Micro Wax (8±2%)]	33 ± 2	
Potassium Sulphate (K_2SO_4)	17 ± 2	
Dimensions	As per Drg.	
Raw material Spec. Reference	OFN/SPEC/RAW MAT/M92/BWRL/00	

13.2 LIST OF DRAWINGS

Sl.	Assembly/ Component	Nomenclature	OFN Drawing No.
1	BWRL	Bore Wear Reducing Liner for 155 mm BMCS M92	BMCS-M92-BWRL-01

13.3 SPECIFICATIONS OF RAW MATERIALS FOR BWRL:

Specification No. OFN/SPEC/RAW MAT/ M92/BWRL/00

Sl. No.	Raw Material Used	Test parameter	Spec. limit	Test Method
1	Titanium Dioxide (Rutile)	Purity as TiO_2 %	93 Min	IS 411:1991
		Relative density	4.0 ± 0.7	SLM 1038.2
		Particle larger than 45 µm (in %)	0.25 Max	
2	Potassium Sulphate (K_2SO_4)	Potassium Sulphate %	99.0 Min	SLM 1026.1
		Volatile Matter %	0.2 Max	
		Acidity (H_2SO_4)%	0.005 Max	
3	C80 Wax	Congealing point (^{0}C)	80 - 85	ASTM D 938
		MEK Soluble (g/100g)	0.5 Max	
4	Micro crystalline Wax	Drop Melting Point (°C)	74-85	ASTM D 127
		Mineral Acidity	Nil	IND- ME- 868 (PROV)
		Matter insoluble in Carbonate Chloride % max	0.10	
		Ash on Incineration, % max	0.10	ASTM D 127
5	Non Woven cloth	Ash Content %	2.0 Max	MIL-C 40070
		Weave	Plain	Visual Insp.

Annexure-A

Raw Materials offered for sampling and Inspection:
Product Name:

Sl. No.	Nomenclature of Item/ Store	Drg. No./ Part No.	Raw Material Name	Specification No.	Offered Qty

Authorized signatory

Annexure-B

Guarantee/ Warranty Certificate

We hereby declare that the product..... quantity ..... supplied by our company M/s..... vide Challan No..... Dated..... as per S. O. No..... Dated..... are meeting all requirements laid down in the relevant specification.

We hereby undertake to replace whole and/ or part consignment as the case may be in the event of it is not meeting the requirements/ standards laid down in the supply order. This Guarantee/ Warranty Certificate is valid till ..... months from date of receipt at O. F. Nalanda.

Quality Control Manager

Managing Director/General Manager
or his authorized Signatory

Supplier's Stamp

Annexure-C

Raw Material Consumption Report

S.O. No:..... Date:..... Supplied Qty.....
Product Name.....

Sl. No.	Raw Material	Accepted Qty	Ref. Document of QC,OFN	Last Consignment balance Qty. (Total)	Present Consignment Consumed Qty.	Present Consignment (balance) Qty
A	B	C	D	E	F	G

Authorized signatory

RESTRICTED

Monitoring Instructions for Procurement of Input Components of 155 mm BMCS

No. OFN/MI/BMCS/M92/BWRL/00
Revision.00
Dated 06/12/2024

Bore Wear Reducing Liner (BWRL) for 155 mm BMCS M92 HZ

1.0 This Monitoring Instruction (MI) shall be applicable invariably as Addendum of Quality Assurance Plan (QAP) no. OFN/QAP/BMCS/M92/BWRL/00, Rev.00, dated 29.03.2024. MI shall be strictly followed/ complied by all the interested parties.

2.0 Supplier/ manufacturers on receipt of Supply Order (SO) should invariably check the correctness of the SO in respect of item description, drawing no., specification, delivery period, place of inspection, inspection authority and quality clauses.

3.0 Supplier/ manufacturer shall offer all the raw materials as required for manufacturing of BWRL for sampling to the CGM, OFN in the format as per Annexure 'A' of QAP, mentioned in Para 1.0 above, on supplier's / manufacturer 's letter head. Supplier/Manufacturer may offer raw materials for entire Supply Order qty. at their own risk and cost.

4.0 For Inspection and acceptance of raw materials, clause no. 6.3.2, 6.3.3, 6.3.4 of QAP, mentioned in Para 1.0 above shall be applicable.

5.0 **Source Development Open Tender Enquiry (SDOTE) Cases:**

5.1 **Advance Sample Qty.: 50 nos.**

a. Advance samples shall be manufactured from the approved/cleared raw material and submitted to OFN along with pre-inspection report, raw material consumption report etc. for inspection (Physical and chemical inspection as well as user/ fitment trail).
b. The inspection and acceptance of advance samples shall be done as per provisions of QAP, mentioned in para 1.0 above.
c. After satisfactory inspection report (Physical and chemical inspection as well as user/ fitment trial), supplier/manufacturer shall be accorded clearance to manufacture a Pilot Lot and offer the same for the inspection.
d. In case of rejection of advance samples, supplier/ manufacturer may submit subsequent advance samples free of cost for the inspection. Advance samples shall be in exclusion to the Supply Order Qty.

5.2 **Pilot Lot: Lot Size: 10800 nos.**

5.2.1 Upon getting clearance from OFN to manufacture a Pilot Lot, the supplier/ manufacturer shall manufacture and offer a pilot Lot for inspection along with following documents/reports :
a. Pre inspection and in-process inspection reports of BWRL as per relevant Drawing and Spec.
b. Raw material consumption and balance statement as per Annexure-'C' of QAP, mentioned in para 1.0 above on supplier's/manufacturer's letter head.
c. Safety certificate and guarantee/warranty certificates for every consignment as per Annexure-'B' of QAP, mentioned in para 1.0 above on supplier's / manufacturer's letter head.

5.2.2 Inspection and acceptance/rejection thereof, of Pilot Lot shall be done as per provision of QAP mentioned in para 1.0 above.

5.3 **Bulk Production Clearance (BPC):**

After acceptance of the pilot lot, BPC will be accorded to the supplier/manufacturer. For subsequent supplies, QAP, mentioned in para 1.0 above shall be the guiding document.

6.0 **Open Tender Enquiry (OTE) / Limited Tender Enquiry (LTE) / Option Clause (OC) Cases:**

Inspection and acceptance/rejection thereof, shall be done as per provision of QAP mentioned in para 1.0 above.

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कृते मुख्य महाप्रबंधक