

RESTRICTED
(DRAFT/PROVISIONAL)
QUALITY ASSURANCE PLAN
FOR
(BEVEL GEAR)
DRG. NO. 176.23.118-4
(LF NO: 6201023062)

No.HVF/T-72C/QAP/23/BEVEL GEAR/391704-00

ISSUE No: 00

DATE:NOV 2021

QUALITY ASSURANCE (RIG-ASSEMBLY)
HEAVY VEHICLES FACTORY
AVADI, CHENNAI – 600 054

QUALITY ASSURANCE PLAN (QAP)

FOR

BEVEL GEAR


DRG. NO. 176.23.118-4

PREPARED BY



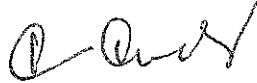
(M. MOHAMMED KHAN)
JWM/QA (RIG-A)

REVIEWED BY



(V. Bhasan)
JWM/ QA (RIG-A)

APPROVED BY



(A. ANNACHAMY)

AWM/QA-RIG-(A)

ISSUED BY

QUALITY ASSURANCE (RIG-ASSEMBLY)

HEAVY VEHICLES FACTORY

AVADI, CHENNAI – 600 054

Sl. No	CONTENTS	PAGE .No.
1.	IMPORTANT NOTES	4
2.	INTRODUCTION	4
3.	AIM	5
4.	SCOPE	5
5.	DOCUMENTS	5
6.	COMPONENTS USED ON	6
7.	BILL OF MATERIAL	6
8.	CONDITIONS OF USE/ STORAGE INSTRUCTIONS	6
9.	SAMPLING PLAN	7
10.	VISUAL INSPECTION	7
11.	DIMENSIONAL CHECKS	8
12.	MATERIAL CHECKS	8-9
13.	FITMENT / PERFORMANCE TEST/ TRIAL	9
14.	INSTRUMENTS/GAUGES & CALIBRATION CHECKS	9
15.	MARKING/IDENTIFICATION CHECKS	10
16.	PRESERVATION CHECKS	10
17.	PACKING CHECKS	10
18.	DOCUMENTATION	10
19.	REFERENCE	11
20.	ANNEXURE-A	12
21.	FIGURE	13
22.	APPENDIX-A	14

1. IMPORTANT NOTES:

Note-1

This is only a provisional and will be amended from time to time according to the requirement. No addition, deletion and reproduction will be done without the permission of The General Manager, Heavy Vehicles Factory, Avadi, Chennai – 54.

Note-2

Any instruction contained in this does not prejudice the terms and conditions of the contract what so ever. In case of any contradiction between the contents of this QAP and the clause in the contract, the latter will prevail.

Note-3

The stores should be manufactured strictly as per the drawings supplied by the Inspection Authority only and not as per the samples, if any received by the manufacturer for guidance purpose.

Note-4

Any amendment issued by the Inspection Authority shall be incorporated in the QAP and the records for the amendments carried out should be maintained as per the Performa at Appendix-"A".

Note –5

. In case of any contradiction between the contents of this QAP and drawings issued along with the contract, the latter will prevail.

2. INTRODUCTION

- a) This quality plan lays down the inspection and testing procedure to be carried out on the **BEVEL GEAR TO DRG.NO. 176.23.118-4** being procured indigenously. This is prepared, based on the acceptance standards and inspection parameters laid down in collaborators documents and on the inspection test standards followed in respect of similar indigenous items.
- b) This QAP is the property of Government of India and is liable for amendments as and when required. The General Manager, Heavy Vehicles Factory, Avadi, Chennai – 600 054, is the inspecting Authority for this assembly. Any query / clarification on the content of this QAP shall be referred to this Factory. Any departure from these instructions is allowed only after written approval from the above authority. Notwithstanding the tests indicated in this QAP, the inspecting Officer has the right to carry out any test to check conformance to the paper particulars quoted in the Supply Order, which he may consider necessary to satisfy himself about the stores which he has to accept.

3. AIM:

The QAP is aimed at standardizing the Inspection procedure and acceptance norms for **BEVEL GEAR TO DRG.NO. 176.23.118-4**. It also aims at giving adequate information to the manufacturer on the quality requirements so that the required quality control methods are established. This is also meant to guide authorized Inspection Officer in his routine inspection and to set out main points to which his attention must be drawn to ensure that the accepted stores meet the stipulated standards.

4. SCOPE:

This QAP outlines in general terms, the checks and methods to be used during inspection of **BEVEL GEAR TO DRG.NO. 176.23.118-4** including the technical requirements of the drawings. The recommended Quality Plan stipulated herein is mandatory and should be strictly adhered to.

Note:

- i. Tender enquiry (TE) and supply order (S.O) will be issued with QAP stating that inspection will be done as per QAP.
- ii. In case of TE, It is responsibility of the vendor to obtain the copy of QAP and give the statement of compliance that vendor will abide by the QAP in case supply order is placed.
- iii. In case of S.O, it is the responsibility of the vendor to obtain copy of QAP and give the statement of compliance that the vendor will follow QAP. However, GM/HVF reserves the right to revise/update the QAP from time to time.

5. DOCUMENTS:

- a) On placement of firm supply order, one set of certified drawings will be forwarded to the Contractor. One set of relevant specification and technical instructions on the subject item can be obtained from AHSP through DDO/HVF.
- b) Any clarification required on these documents should be obtained from the Inspecting Authority i.e. The General Manager, Heavy Vehicles Factory, Avadi, Chennai – 600 054. Equivalent to the collaborators specifications and standards will be decided only by the Inspecting Authority and should not be unilaterally decided.
- c) The process instruction sheets supplied by the collaborators are available with the DDO/HVF, Avadi, Chennai for reference (i.e. Forging, casting, machining, manufacturing, extrusion, forming, heat treatment and plating process etc..). Where ever applicable.
- d) The supplier after scrutiny of the concerned process sheets and connected paper particulars should establish the necessary production and inspection facilities. Particularly the inspection test rigs, stands, fixtures, templates, gauges etc should be provided as recommended in these process sheets facilities. Particularly the inspection test rigs, stands, fixtures, template, gauges etc should be provided as recommended in these process sheets.

6. USED ON HIGHER ASSY:

The component BEVEL GEAR to drg.no. 176.23.118-4 is used on higher assembly to drg.no. for bulk production.

7. BILL OF MATERIALS:

SI. NO	DRG. NO	NOMENCLATURE	MATERIAL SPECIFICATIONS	REMARKS
1	176.23.118-4	BEVEL GEAR	STEEL 20X2H4A GOST 4543-711	

Note: Vendor/Contractor may use approved alternate material issued by the Tender/ supply order issuing authority in writing (if available).

8. CONDITIONS OF USE/STORAGE INSTRUCTIONS

This component should be properly packed to protect from transit / handling damage and influence of atmospheric precipitations. In addition, the following parameters should be ensured: -

- a) Each component shall be separately packed properly.
- b) The stores are to be suitably covered for preventing ingress of dust and Dirt/entry of sunlight and moisture.
- c) The packaging slip shall contains;
 - i. Certificate of testing (NABL)
 - ii. Pre- inspection report (PIR)
 - iii. Guarantee/ Warranty Certificate
 - iv. Delivery Slip with Inspector's Acceptance Mark
 - v. Under taking certificate/certificate of conformance
- d) The stores are not permitted to be stored together with oils. Petrol, acids, alkaline and other substances to avoid damage to the metal / rubber components.

9. SAMPLING PLAN:

Sl. No.	Sampling Plan	Pilot *	Bulk
i.	Visual Inspection	100%	100%
ii.	Dimensional Checks	100%	General Inspection level II, single sampling, Normal Inspection, AQL 1.5 as per IS 2500 (Part-I)-2000
iii.	Material Checks	1 No	1 No for each batch of raw material or heat treatment lot as required by specification.
iv.	Fitment/ Performance test /trial	1 No	1 No as and when required
v.	Test stands/jigs/ fixtures/ gauges and calibration checks	100%	100%
vi.	Marking/ Identification	100%	100%
vii.	Packing/Preservation	100%	100%

* This clause is applicable if mentioned in supply order or project sanction order in case of Make-II.

Note: - A New supplier should supply bulk only after pilot sample inspection /evaluation by HVF and obtain bulk production clearance from HVF.

10. VISUAL INSPECTION [Sampling plan as per Para- 9 (i)]

The stores are to be visually examined on 100 % of pilot /bulk and same should be free from any defects and all the finishing requirements shall satisfy as indicated in technical conditions/requirements of the assy / components drawing respectively.

The components shall be checked for the following and should be free from the defects:

- Defects in construction
- Dents, scratches and cracks etc
- Presence of foreign particles
- Moisture and dust
- Corrosion of metal parts
- Mechanical imperfections & distortion
- Any form of deterioration of material and finishing.

Packing and preservation should be ensured as per drawings/relevant TY specifications (To be ensured on receipt at consignee end).

11. DIMENSIONAL CHECKS [SAMPLING PLAN AS PER PARA- 9(ii)]

The dimensions of the component shall be checked and ensured as per drawing no.176.23.118-4. Dimensional check should be carried out as per sampling plan. However, the inspecting authority/rep. may at his discretion, tighten the inspection level and acceptance quality level on the critical items and adopt check point during manufacture.

11.01 BEVEL GEAR (176.23.118-4)

- a) All the dimensions and geometrical parameters should be confirmed as per drawing specifications.
- b) All Technical requirements (T.R) points to be ensured as per drawing.

1. BHN 269...341. Check on blank.
2. Surfaces marked in dotted line, should be subjected to high temperature cyaniding h 0.3...0.8 mm ≥ 73 HRA. Check on sample piece. Presence of cyaniding layers on surface D and E is allowed. Depth and hardness on surface B need not be checked.
3. Nitriding for $h \geq 0.15$ mm, ≥ 500 HV is permitted.
4. High temperature tempering is allowed on surface F over the entire thickness of flange.
5. Dimensions K and runout tolerance of surface D to be checked before cutting of tooth.
6. Dimensions in brackets – after assembly.
7. *Dimensions for reference.
8. *¹Dimension to be ensured by tool.
9. Check the butting of teeth of the gear wheel with mated teeth of gear 176.23.1173 – 3 as per the bearing pattern, which should be from 30 to 80% of length of tooth from either side.
10. Mark the pairness number with parts 176.23.117-3 and mounting distance for parts 176.23.117-3. It is allowed to mark the rate of deviation valve from nominal mounting distance (88 mm) expressed in decimals of mm with symbol“+” or “-” respectively, instead of mounting distance. In case of absence of deviation mark “0”.
11. Coating: Chemical phosphotizing, oxidizing and oil finish or chemical oxidizing oil finish.
12. Other requirements are as per specification 520.TY1.

Module		m	4
No. of teeth		Z	41
Type of tooth			circular
Spiral angle		β	38°58'52"
Direction of tooth			
$\frac{1}{2}$	Profile angle	α	20°
	Addendum	h_a	1.996
	Tooth depth	h	7.36
	Fillet radius	r	0.8
Addendum modification coefficient		x	-0.326
Pitch angle		δ	77°37'5"
Accuracy as per GOST 1758-81			---
Circumferential back lash	Value	C_u	0.055 - 0.182
	Deviation	δ_{foc}	0.053
Bearing pattern	Along length		Not less than 60%
	Along height		Not less than 60%
Thickness of tooth along chord in normal section (for external cone)		$S_{x'n}$	3.63 -0.11 -0.20
Measuring height along chord		h_k	1.95
Gear cutting method			Double sided
Thickness of tooth on arc of reference circle		S_a	6.07
Dimensions of tool heads	Diameter	D_d	152.4 or 160
	Deviation of cutting tools	W	1.629
	Cutting tool no.	N	10
Root cone angle		δ_r	73°57'48"
Designation of drawing of mating gear			176.23.117-3

12) MATERIAL CHECKS [SAMPLING PLAN AS PARA – 9 (iii)]

Material specimen /test bars of the components shall be in conformity as per the material mentioned in the relevant documents/drawings as per the bill of materials (BOM). NABL test reports for all the parameters as per relevant specifications to be submitted. Test samples to be submitted by the vendor to HVF, if required. The material check will be carried out as per sampling plan. However, if the manufacturer proposes any alternative material at the stage of tender enquiry, the same has to be approved and a written concurrence should be obtained from AHSP through DDO/HVF, before usage of such materials.

12.1 BEVEL GEAR (176.23.118-4)

- The component should be manufactured from STEEL 20X2H4A GOST 4543-71.
- The chemical composition and mechanical properties of STEEL 20X2H4A GOST4543-71 given below ,for other requirements refer GOST 4543-71.
- THE gears parameters as per drg specification is given below.

13 a) CHEMICAL COMPOSITION: AS PER STEEL GRADES 20X2H4A & 18X2H4MA GOST 4543-71.

GRADE OF STEEL	CONTENT OF ELEMENTS %							
	C	Si	Mn	Cr	Ni	Mo	S	P
							MAX	
20X2H4A	0,16-0,22	0,17-0,37	0,30-0,60	1,25-1,65	3,25-3,65	—	0,025	0,025

ii) RESIDUAL CONTENT OF COPPER SHOULD NOT EXCEED 0,30 %

iii) TECHNOLOGICAL CALCULATED ADDITION OF TITANIUM UPTO 0,06 % WITH OUT CONSIDERING MELTING LOSS IS ALLOWABLE IN STEEL GRADE 18X2H4MA.

b) MECHANICAL PROPERTIES. AS PER STEEL GRADES 20X2H4A & 18X2H4MA GOST 4543-71.

GRADE OF STEEL	TENSILE STRENGTH	YIELD POINT	ELONGATION	REDUCTION IN AREA	IMPACT STRENGTH
	Kgf/mm ²	Kgf/mm ²	%	%	Kgm/cm ²
	M I N I M U M				
20X2H4A	130	110	9	45	8

13. FITMENT /PERFORMANCE TEST/ TRIAL:

- Pilot samples should be checked for fitment / Performance test to ascertain the efficacy of the item or component by fitting in higher assembly and repeating it for functional checks, wherever required.
- Bulk supply may be subjected to performance trial in higher assembly in case of repeated failure/defects during exploitation.

14. INSTRUMENTS/GAUGES & CALIBRATION CHECKS;

- a) The supplier / Contractor should have suitable instruments and gauges to carry out quality checks and to ensure conformance of components as per drg. Specification / T.R points.
- b) The supplier/contractor should submit calibration reports for instruments/fixtures/gauges etc., which are used during inspection activities.

15. MARKING/IDENTIFICATION CHECKS;

For traceability, marking of part No., Manufacturer name, supply order No, Serial No/Qty, batch No. and manufacture date & year are to be carried out in all components. Suitable method of marking can be adopted, provided the above details are legible. Inscription if any as called for in the relevant drawing is also to be carried out.

16. PRESERVATION CHECKS;

- a) Preservative coatings are to be strictly adhered to as called for in the drawing. However, equivalent BIS Standards can also be followed, subject to the thickness of the coating is maintained as per the drawing.
- b) Other preservations as necessary to prevent damages due to moisture and dust during process, storage and transit are to be carried out. Conventional Methods can also be resorted to.

17. PACKING CHECKS;

- a) Components are to be packed separately to avoid damages during transit / handling of the same. Part No. and No. of sets are to be marked on the packing.
- b) Packing and preservation should be ensured as per drawings/relevant TY specifications (To be ensured on receipt at consignee end).

18. DOCUMENTATION;

- a) Firm has to maintain all the documents as per QAP with respect to the Sl.No.to have traceability.
- b) Vendor has to submit Bill of materials, Material test reports, Class 'C' /Endurance test reports (wherever specified in drg/TY specification/QAP) and Complete PIR (pre-inspection report)at the time of offering the item for inspection. HVF will commence the inspection only after scrutiny of these documents.
- c) Pre inspection reports (PIR) of firm like,
 - 1) Chemical analysis, Mechanical properties obtain from NABL as per bill of material (BOM) with respect to material specification,

- 2) Pre-forming process report as per process sheet,
 - 3) Coating certificate, hardness reports and heat treatment certificates (wherever applicable)
 - 4) Calibration reports of instruments and gauges,
 - 5) 100% Dimensional inspection reports (including T.R points) as per bill of material are to be submitted.
- d) The testing/inspection responsibility to test all the parameters as per QAP and drawing specifications as mentioned in Annexure -A (enclosed).

19) REFERENCE:

- a. Refer the drawings to 176.23.118-4
- b. Refer all material specifications like, GOST, IS & TY etc... refer dimensional and material checks clause in this QAP.

SL. NO	CATEGORY	TESTS/INSPECTION PARAMETERS	STANDARDS TO BE REFERRED	ACCEPTANCE CRITERIA	INSPECTION RESPONSIBILITY			REMARKS
					Firm	HVF	DGQA	
1.	Pre inspection reports (PIR) of firm	Firm has to produce all the document as per QAP Para no. 18	As per the relevant drawing and QAP.	Conform to drawing and QAP as per bill of material	P	V	R	100% by firm/ vendor.
2.	Dimensional checks	Dimensions as per the drawing	Drawing/QAP Para no: 11	Conform to drawing and QAP	P	W/P	R	100% by firm/ vendor, SP followed by HVF.
3.	Material checks	Chemical & Mechanical Properties	QAP Para no: 12	conform with QAP and Drawings (para.12.)	P	W/V	R	REFER NOTE
4.	Coating checks	Coating	QAP Para no 11	conform to QAP Para no 11	P	V	R	100% by firm/ vendor.
5.	Marking / Identification checks	Marking / traceability	QAP Para no 15	Conform to QAP Para no 15	P	V	R	100% by firm/ vendor.
6.	Preservation & packing	Preservation & packing	QAP Para no 16 & 17	Conform to QAP Para no 16 & 17	P	V	R	100% by firm/ vendor.

Note:

- 1) One sample per heat/batch shall be tested under NABL Lab/Govt. Approved lab by firm. In case of non-compliance to standards entire lot will be rejected or not to use in production further.
- 2) For cross conformation, manufacturer has to submit test samples /HVF will draw samples from supplied lot on receipt for Witnessing (W) at HVF premises. In case of non-compliance to standards entire lot will be rejected.

P- Perform W- Witness V-Verify R-Review SP-Sampling Plan

APPENDIX 'A'

RECORD OF AMENDMENTS

Sl. No	Amendment No. & date	Amended by	Date of Insertion	Initial