Product Innovation Report
Yaw Roller Nut
14 March 2017

Hood Tech Quality Assurance Policies proscribe the shipment of products with known design flaws. This report informs you of a specific product innovation triggered by 1) Design flaw discovery, 2) Product obsolescence or 3) Other.

1. Product Innovation Summary: Yaw Roller Nut, eliminates failure mode resulting from imperfect wrench-turning technique.

2. Reason for change (check one)

- ✓ Design flaw discovery (explain): Yaw rollers break off when imperfectly installed.
- ❑ Sub-component obsolescence (identify component): _____
- ❑ Other (explain): _____

3. Customer Impact

Open purchase order(s) affected: tbd

Hood Tech Part Name: Yaw Roller Nut

Serial number/date of manufacture of first article affected: _____

Cost increment: Hood Tech offers this upgrade at zero additional cost for open orders and new orders through March 2017. Retrofit kits offered at $487/each (2017 pricing, subject to change) .

4. Response

No response is required. If more information is desired, please contact:

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Yaw Roller Nut

Introduced February 2012
Document updated 14 March 2017

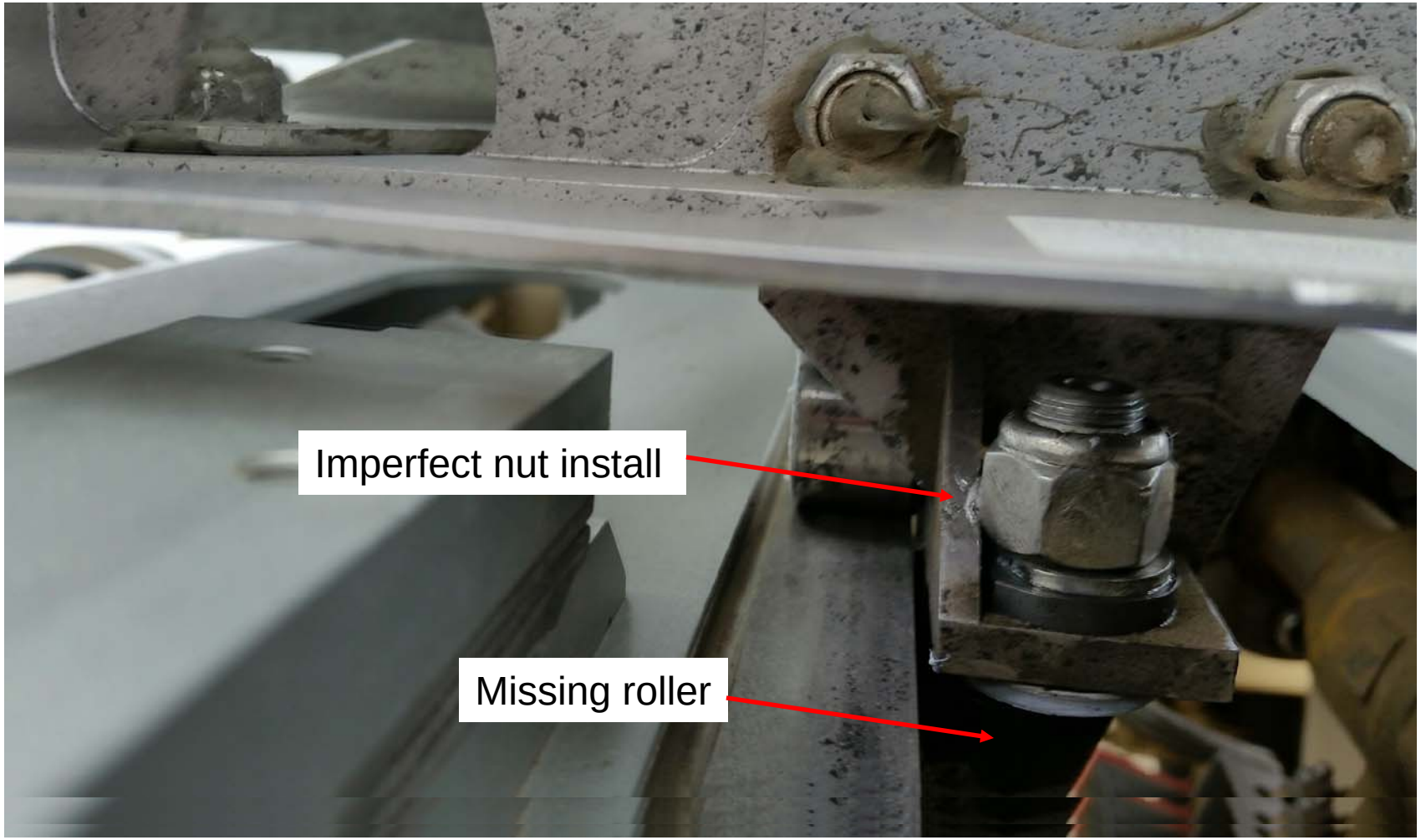
Failure History

as reported to Hood Tech

- At least 4 production rollers have failed due to improper installation. In all cases, installer was fully qualified, had proper training and years of experience in this field
- Rollers are routinely replaced in the field by operators who have far less experience replacing yaw rollers.
- Technicians who may have observed such failures in the field would unlikely report them, as replacement parts are readily available in the spares kits. These individuals would likely seek to avoid the embarrassment associated with sloppy wrench-turning
- 1 failure occurred during assembly
- 3 failures occurred during launcher check-out inspection
- **March 2017 update:** On 9 March 2017, a yaw roller failed during a live (N20-equipped aircraft) customer demonstration. The launch was reported "slow" by the flight ops personnel, and the observed climb-out confirmed this. The aircraft pitched down and **descended** off the launcher to build airspeed, threatening ground impact for several seconds before finally climbing to safe altitude. The failed roller was found, post launch, many meters downrange.

Live Launch Failure During Customer Demonstration

Boardman Test Range, 9 March 2017



Failed Roller Stud Samples;

reveal evidence of failure due to overload; in each case pronounced scraping of the aluminum gusset confirms nut was imperfectly held during installation.

Failure Analysis

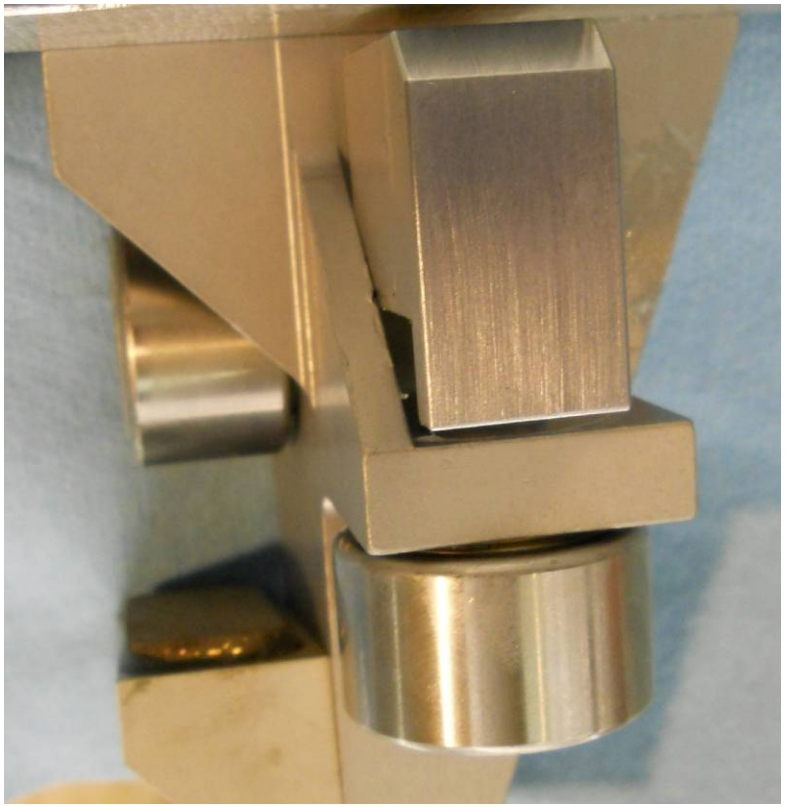
- When a standard COTS hex nut is used to secure a yaw roller, it can bind along the caster bracket gusset surface, inducing a residual bending moment exceeding 1000 in-lbs at the notched section of the roller stud. The tensile stress at the notch exceeds 285ksi (the ultimate strength of 440C material), and the stud fails.
- Depending on machining tolerance, install torque and geometry, it's also possible to have install stress in the 200-250ksi range, and the additional stress of loading the carriage onto the Mark 4 track causes the total stress to exceed 285ksi, and the shaft fails.

Installation

In both cases, stud is turned from below using hex key; both nuts have corrosion resistant locking feature

Baseline; careful, 2-wrench technique is required to prevent nut binding

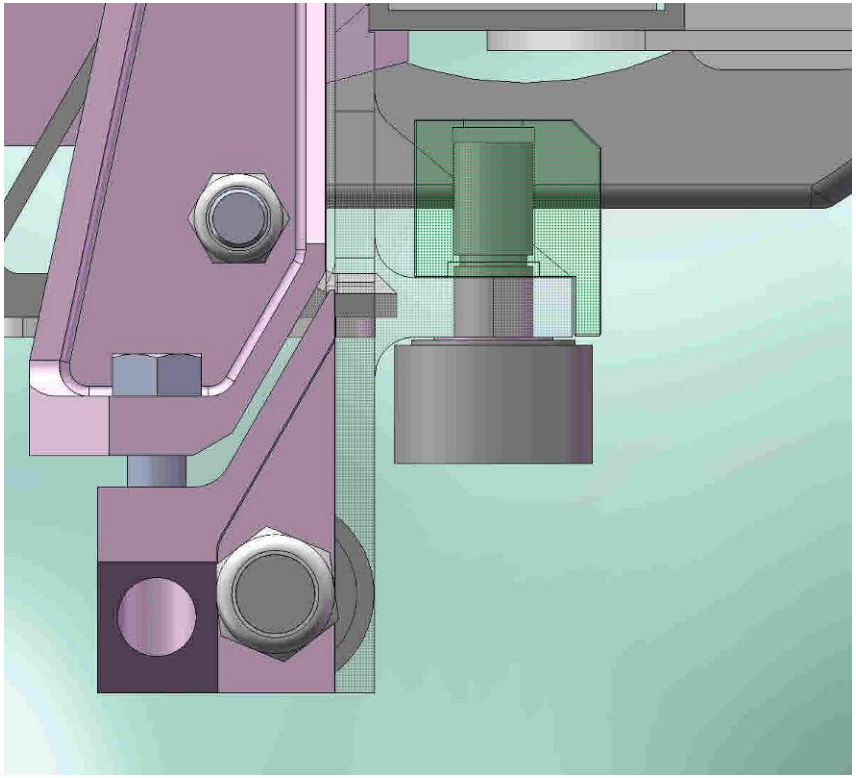
Self-guided yaw roller nut; second wrench is not required



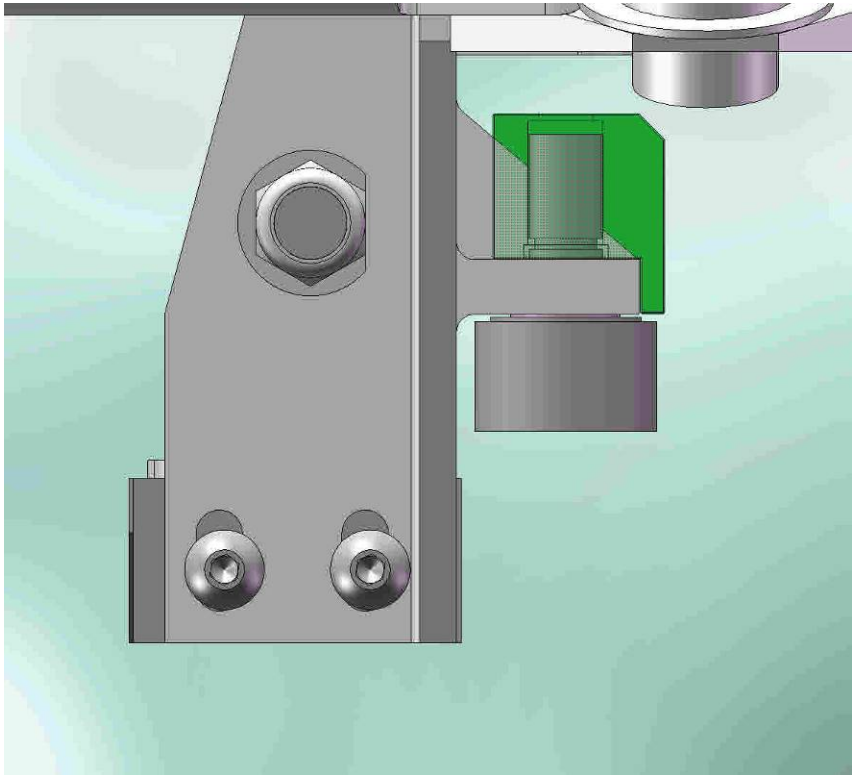
Rollers Installed

Upgraded configuration with yaw roller nuts on yaw rollers, standard nuts used for pitch restraint; self-locking helical inserts not shown, for simplicity

Forward



Rear



Rollers Installed

Upgraded configuration

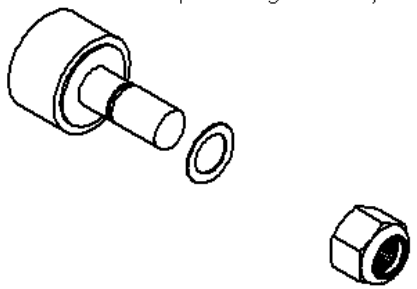
Forward

Rear

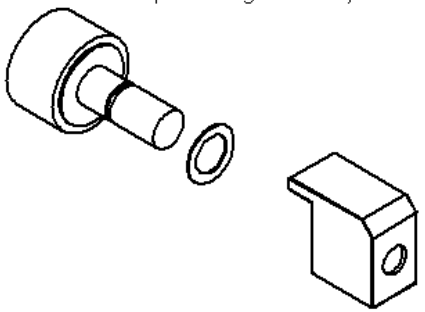
5-Years of Data

- Since 2012, the yaw roller nut upgrade has been in regular use on Hood Tech's Mark 4-3 Light, and on two carriages in regular service in Boardman. The yaw roller nuts have performed nominally in all cases.

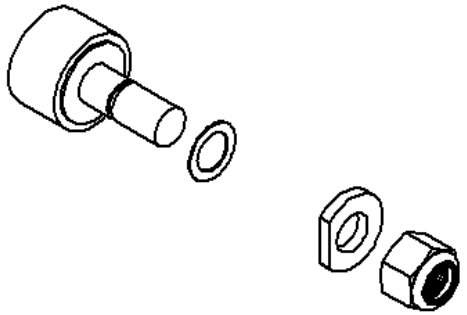
Front pitch restraint positions
2 per carriage assembly



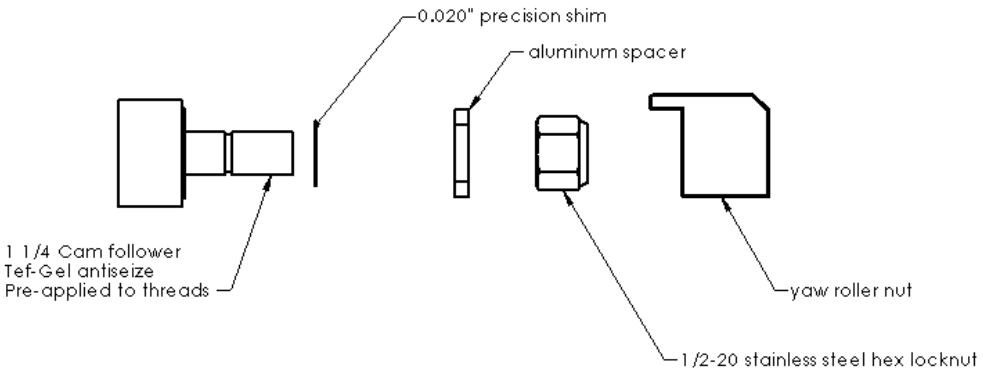
Yaw Roller positions
4 per carriage assembly



Rear pitch restraint positions
2 per carriage assembly



Kit contents - accomodates all positions
1 of each piece per kit



VICD: Spare Roller Assembly

with yaw roller nut included
Revised part #030-030010-000

DIMENSIONS ARE IN INCHES
TOLERANCES:
.XX +- .01"
.XXX +- .005"
Angles +- 1 deg
except were noted.
DO NOT SCALE DRAWING

MATERIAL

FINISH

	NAME	DATE
DRAWN	CCR	
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

Hood Technology Corp.

Filename:
Roller assembly with yaw roller nut

Configuration:
kit contents

SIZE A | Print Date: 2/10/2012 | Version: A-03

SCALE:1:2 | WEIGHT: | SHEET 1 OF 1

REV.	DESCRIPTION

C:\Cory\PDMTemp Files\

Retrofit Offered

Hood Tech offers the yaw roller nut upgrade as an aftermarket product, available immediately from stock on hand.

<u>For more info, contact:</u>

info@hoodtechmechanical.com

Hood Tech Corp, Mechanical Inc