

Q&A

VEXU 2019-2020: Tower Takeover

Tagged: VUR3



Welcome to the official VEX Robotics Competition Question & Answer system, where all registered teams have the opportunity to ask for official rules interpretations and clarifications. This Q&A system is the only source for official VRC Tower Takeover rules clarifications, and the clarifications made here from the Game Design Committee (GDC) are considered as official and binding as the written [Game Manual](#) itself.

Please review the [Q&A Usage Guidelines](#) before posting. This system is only intended for specific VRC Tower Takeover rules questions.

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98: <VUR3> Casting Silicone, Polyurethane or Rubber

4-Oct-2018

VEX U VUR3

Our team is interested casting uncured resins of silicone, polyurethane, or rubber into parts for our robot. While these are not legal materials listed in <VUR3>, we believe this is in the spirit of the rule because we developing our own fabrication process for these materials and not using prefabricated commercial parts. Would fabricating parts out of these materials in this fashion be legal and in the spirit of the rule?

Answered by Game Design Committee

As you noted, these are not materials or fabrication processes that are currently included in VUR3. Thus, they would not be legal. However, we will take this into consideration for future seasons.

708: <VUR6> Clarification

7-Dec-2020

R6 R7 R8 R10 R12 R20 R22 VUR2 VUR3 VUR5 VUR6 VUR8

In this previous ruling, it was determined that <VUR5> takes priority over <VUR6>:

<https://events.vex.com/VEXU/2020-2021/QA/674>

However, this is contradictory to every other instance of past rulings regarding <VUR6> and the wording of <VUR6> in the game manual.

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For example, consider a typical custom sensor such as the pixy camera:

<https://www.robotshop.com/en/charmed-labs-pixy-2-cmucam5-image-sensor.html>

This sensor violates <R6>, <R7>, <R8>, <R10>, <R12>, <R20>, <R22>, as well as <VUR3> and <VUR8>.

VUR3 restricts the materials allowed, but this sensor violates the allowed materials.

VUR8 restricts the screw sizes allowed, but this sensor may have smaller screws than the allowed limit.

As another example, consider a vex IQ sensor: <https://www.vexrobotics.com/228-3014.html>

This sensor would violate <R6>, <R7>, <R8>, <R10>, <R12>, <R20>, <R22>, as well as <VUR3> and <VUR2b>.

<VUR2b> restricts teams from using any vex IQ electronics, which would include this sensor.

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Because <VUR6> specifically states "There is no restriction on sensors and other additional electronics that Robots may use for sensing and processing" it has been understood by most VexU teams that <VUR6> takes priority over all the other rules in the game manual. Logically this would also mean <VUR6> would take priority over <VUR5>.

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Several other Q/As over the years have verified this as correct as the wording on <VUR6> has not significantly changed since these rulings:

<https://www.vexforum.com/t/answered-vexu-speakers-as-part-of-custom-sensor/42312>

<https://www.vexforum.com/t/answered-vex-u-old-college-q-a-updates/23810>

<https://www.vexforum.com/t/answered-custom-sensor-housing/19582/2>

These three Q/As verify that <VUR6> would take priority over <VUR3> and <VUR8> as well as all the regular game manual rules mentioned above.

Furthermore, the following Q/A shows that <VUR6> would also take priority over <VUR5>:

<https://www.vexforum.com/t/answered-vex-u-non-vex-servo-motors-for-a-custom-sensor/35538>

This allowed external non vex motors used solely for manipulating custom sensors.

If this were the case, it would agree with the wording of <VUR6>. There are numerous sensors and processing boards that rely on motors to operate.

For example, many full field lidar systems such as:

<https://www.robotshop.com/en/rplidar-a1m8-360-degree-laser-scanner-development-kit.html>

rely on an integrated motor to spin the lidar enabling it to map the field. VexU teams have legally used similar lidar systems in the past and may plan to do so again this season.

Another example would be the Nvidia Jetson Xavier NX listed below:

<https://www.nvidia.com/en-us/autonomous-machines/embedded-systems/jetson-xavier-nx/>

This processing board has a built-in fan on its heatsink that is critical to its function as a processing unit.

A third example is the pixy tilt and pan kit: <https://pixycam.com/pixy2-pan-tilt-kit/> (ruled legal in the above Q/A linked).

Without these integrated motors, none of these sensors or processing units could function as intended.

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Therefore, which rules, if any, restrict the "no restriction" clause of <VUR6>?

Furthermore, if <VUR5> does not apply to <VUR6>, then was the previous ruling in QA#674 an error?

If <VUR5> is applicable, are 360-degree Lidar sensors and the Nvidia Jetson processing boards also illegal? If all VexU appendix rules also apply to <VUR6>, then does that mean that there are no legal VexU custom sensors?

Answered by Game Design Committee

If all VexU appendix rules also apply to <VUR6>, then does that mean that there are no legal VexU custom sensors?

Please see rule G3:

<G3> Use common sense. When reading and applying the various rules in this document, please remember that common sense always applies in the VEX Robotics Competition.

The intent of the answer in the linked Q&A was to prohibit using VUR6 as a loophole to install cooling fans on a Robot.

Sensors containing an internal motor which is integral to their operation, such as a LIDAR or pan-tilt Pixy, would be permissible. It would not be feasible for an inspector to take apart a LIDAR module to see if there is a motor inside of it. It is, however, feasible for an inspector to check if a fan is being used to cool a V5 Smart Motor.

To prevent confusion, we would advise Teams with external processors that require thermal protection to utilize a [passive heat sink](#) instead of an active cooling fan.

656: Is wood a legal material under <VUR3c>?

22-Sep-2020

<VUR3c> allows "composite materials, such as G10 (Garolite), FR-4, or carbon fiber" to be used in robot construction.

"Composite material" is not further defined in the game manual or any appendices. Wikipedia [defines a composite material](#) as "a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components."

Although naturally occurring, wood [meets this definition](#) - it is composed of cellulose fibers bound together by lignin. Neither cellulose nor lignin individually have similar physical properties to wood, but when combined they form a much stronger substance.

So, is wood a legal material for robot construction under <VUR3c>?

If wood is not deemed legal under <VUR3c>, what about plywood? Plywood is itself a composite material consisting of layers of wood bonded by adhesive. This bonding significantly changes the material properties of the wood (for example, the individual sheets of wood will shrink and expand in one dimension with changes in temperature and humidity, but the composite plywood will not, due to the alternating grain direction).

(Edit to add: And, since <AIR3c> is worded exactly the same as <VUR3c>, would the same answer apply to VAIC as well?)

Answered by Game Design Committee

Yes, wood is a legal material for robot construction within VUR3-c.

617: Follow up to Q&A questions 607 and 613 and VUR3

29-May-2020

VUR3

In Q&A 607 [link](#) it was stated that "tubing, sheet, plate, angle, etc" are examples of raw materials that are legal for use. This was later corrected in Q&A 613 [link](#) to clarify that Angle is not a legal type of stock material due to the last paragraph of VUR3, which states:

Similarly, pre-drilled or extruded metal, such as angle aluminum, is not permitted, unless it can be found on www.vexrobotics.com.

However, tubing was noted to still be legal, as it was said that parts manufactured from tube stock are legal. However, tubes made from materials such as aluminum and steel are often manufactured using some form of extrusion. Even billet aluminum is extruded into its block shape. Since many of the materials that may be considered "stock", and even ones that are explicitly legal, are manufactured through extrusion, will the GDC please clarify the intent of VUR3? Specifically, is VUR3 intended to be based on seemingly arbitrary requirements such as the exact manufacturing process of the stock material, or is it intended to prevent teams from simply purchasing parts that they may not otherwise have been able to manufacture?

Answered by Game Design Committee

This question will be addressed in the August 14, 2020 Game Manual Update.

613: Follow up to Q&A question 607 and VUR3

22-May-2020

VUR3

In a previous Q&A in regards to VUR3 [link](#), it was mentioned that, "tubing, sheet, plate, angle, etc" are examples of raw materials that are legal for use. What I am wondering is exactly where to draw the line. For example, if you take a look here [link](#), McMaster-Carr lists quite a few things under their Aluminum Stock section. You mention that angle is legal, this would lead me to assume the same for C/U channel [link](#) and rectangular tube [link](#), but what about more complex things like balls [link](#), double-wall round tube [link](#), honeycomb cores [link](#) and wire [link](#)? What about things like V-Slot aluminum extrusion [link](#)?

In addition, just to clarify, theoretically could one buy a raw material like an aluminum plate and place it on their robot without modification if they so desired? While I don't see many cases where someone would want to do this, the previously used working could lead someone to believe some amount of modification is required to make a raw material legal for use.

Answered by Game Design Committee

Before diving in, we need to note that the answer previously posted to Q&A 607 incorrectly listed "angle" as a legal material type. This is in direct conflict with the last sentence of VUR3, and has been edited to reflect this correction. We apologize for this error and the confusion that it caused.

With that in mind, hopefully your question becomes more straightforward to understand. The full text of VUR3 reads as follows:

<VUR3> Teams are allowed to fabricate their own unique components for each of their Robots from the following additional raw materials. These parts may be fabricated using techniques that may otherwise be prohibited in VRC, such as welding, brazing, casting, forging, hot/cold rolling, tempering, or gluing.

- a. An unlimited amount of non-shattering plastic from the following list: polycarbonate, acetal monopolymer (Delrin), acetal copolymer (Acetron GP), POM (acetal), ABS, PEEK, PET, HDPE, LDPE, Nylon (all grades), Polypropylene, FEP.
- b. An unlimited amount of silicone, polyurethane, or other rubber.
- c. An unlimited amount of composite materials, such as G10 (Garolite), FR-4, or carbon fiber.
- d. An unlimited number of plastic 3D printed parts.
- e. An unlimited amount of steel, aluminum, brass & bronze.

The intent of <VUR3> is to encourage Teams to explore fabrication techniques like milling, 3D printing, injection molding, sheet metal punching, etc., to develop their own new robotic components in addition to the "standard" set of VEX components permitted by <VUR2> . To utilize these techniques, raw materials from the list provided in <VUR3> may be used.

However, the intent of <VUR3> is not to legalize all commercially available items made from these materials. The only commercial components (other than pneumatic components) that may be used are those purchased from VEX Robotics, as specified in <VUR2>.

For example, aluminum billet may be used to machine a custom bracket. However, purchasing a custom aluminum bracket is not within the spirit of this rule. Similarly, pre-drilled or extruded metal, such as angle aluminum, is not permitted, unless it can be found on www.vexrobotics.com.

The bottom three paragraphs, i.e. the "red box" in the manual, comprehensively explain the intent and spirit of VUR3. It would be impossible to provide a blanket answer that concisely defines all hypothetical materials that can or cannot be used.

If you have a specific item you are concerned about, we are happy to clarify via the Q&A. However, this is an inefficient way to determine component legality in a way that can be consistently applied across all teams, events, and regions; we would prefer to utilize the intent and spirit conveyed in VUR3's red box.

When determining if a given design option is legal, try to ask the following "thought experiment" questions:

"Am I making a brand-new custom part, or am I taking advantage of a feature on a component that I have purchased?"

- Milling slots into a piece of aluminum bar stock would be legal, but buying pre-slotted aluminum would not. The goal of VUR3 is to encourage Teams to explore fabrication techniques of their own.

"Would another team with access to our same fabrication resources (3D printer / CNC mill / manual lathe / metalworking forge / etc) be able to replicate the same custom part with a different commercially available raw material?"

- A tube that is lathed into a custom spacer would likely be functionally similar to another, regardless of whether it was aluminum or steel, or whether you purchased it from McMaster or from a hardware store. A pre-made honeycomb lattice will likely rely on a specific manufacturer in order to be functionally equivalent.

"Can I explain how this part was made in our Engineering Notebook or in a judged interview, or is the answer 'we bought it that way'?"

- We are not going to request that teams submit a piece-by-piece bill of materials to "prove" that items were purchased as raw materials; we are much more interested in the engineering design process and fabrication techniques that you learned and applied to make the part.

593: <R21> Custom Motor Caps for VEXU

16-Mar-2020

VUR3

<R21> specifically states that electronic components, including V5 motors, may NOT be altered from their original state in ANY way. With many of the VRC restrictions being lifted for VEXU (in regard to being able to fabricate custom components per <VUR3>) and with the 2020-2021 season not being released yet, could a consideration be made for next season and beyond to allow VEXU teams the ability to make custom aluminum and/or plastic motor caps? The purpose of this would be to allow for more unique mounting methods to C-channels and other hardware. My team and I find the threaded insert method quite restricting for many reasons but primarily for drive trains. Changing motors on many drive train designs is tedious because a lot has to be taken off just to reach the screws for the motor. Any consideration would be appreciated. Thank you.

Answered by Game Design Committee

Per the [Q&A Usage Guidelines](#), this Q&A system is intended for game rule clarifications only. For game questions, suggestions, or concerns outside of specific and official rules questions, please contact GDC@vex.com.

340: Can VexU teams 3D print custom license plates?

28-Aug-2019

VUR3

Because VexU teams are allowed to create custom parts through 3D printing in <VUR3>, could VexU teams 3D print license plates instead of using the Vex license plates. Teams are already allowed to custom make stickers with the team ID to use on the Vex license plate. If a VexU team 3D printed their license plates where they still had two blue and two red license plates on two opposing side and the text was in a readable large white font would this be allowed? Do the plates need to be the same or similar size to the Vex license plates? Could VexU teams be able to 3D print their license plates and the head ref have final say in if the plates are not readable compared to the Vex license plates and the team then use the Vex license plates? I attached a example of what I am talking about below.



Answered by Game Design Committee

We sincerely apologize for this extremely delayed response. Please see this similar Q&A post, which we believe answers your question. If it does not, please feel free to rephrase and re-submit.

<https://events.vex.com/VRC/2019-2020/QA/363>

292: <VUR3> Clarification on "Stock"

2-Jun-2019

VUR3

We would like some additional clarification on which shapes of stock material are allowed in VEXU per VUR3. The definition of stock material can be considered very broad and we'd like to ensure that we know exactly what we can use before we begin working this season. Some of the stock material we'd like clarification on are:

1. Block (Ex: Used in milling machines)
2. Cylindrical (Ex: Used by lathes)
3. Sheet
4. Tube

Thank you, Afnan Ali MASON

Answered by Game Design Committee

We sincerely apologize for this extremely delayed response. These descriptions would all be considered legal "stock" under VUR3.

237: Using 3D Printer filament

7-Feb-2019

VUR3

I know we can use unlimited 3d printed parts but can we also use the filament itself? Say our printer uses 1.75mm filament. From my understanding of the rules we could not use the filament directly off the spool because it has not yet been 3d printed. My question is if we were to get a 1.75mm nozzle on our 3d printer and extrude the 1.75mm plastic filament would it then be legal? Thanks, Bison1

Answered by Game Design Committee

Yes, this would be legal.

1459: Bearing Balls

16-Feb-2023

VUR3 VUR4

<VUR3> Fabricated Parts may be made using the following processes: a. Adding material, such as 3D printing. b. Removing material, such as cutting, drilling, or machining. c. Bending material, such as sheet metal breaking or thermoforming. d. Casting or molding material, such as injection molding or sand casting. e. Attaching materials to one another, such as welding or chemically bonding (e.g., epoxy).

<VUR4> Fabricated Parts must be made from raw materials. For the purpose of this rule, a "raw material" is any material that would not be considered a "pre-fabricated" part (i.e., has not undergone any of the fabrication techniques listed in <VUR3>).

According to your ruling on [Q&A 1235](#), billets and sheet plastic are considered stock materials although they are cast and rolled. In your ruling on [Q&A 1269](#), a cast gear is considered fabricated and is therefore not a stock material because a billet "is designed to be fabricated into something else," while the gear is "fabricated for the sole purpose of being used as a gear." Additionally, you stated that if "an item is generally intended to be used in the exact state in which it is sold & purchased, it is unlikely to qualify as a raw material under the VEX U competition rules."

From those rulings and the rules in the game manual, is a [ball bearing ball](#) considered a stock material or a prefabricated (therefore illegal). The [manufacturing process of a ball bearing ball](#) is as follows:

1. Wire rod is cut to length. (Although "cutting" is illegal in VUR3a, this should be legal in the same way that it is legal for a long bar of metal billet is cut to individual length. The cutting is not adding complexity, it is shortening the material or detaching it from the spool.)
2. The cut slug is forged to produce a cold-headed ball. (Some metal billets are forged.)
3. Flashing removes the "equator" and "poles" giving the ball a rough finish. (Flashing should be legal since it is not a fabrication technique that is listed in VUR3.)
4. The ball is heat treated (Heat treating is legal according to VUR4.)
5. The ball is ground to approximate size. (Grinding could be classified as "removing material," but it is not expressly illegal in VUR3, and metal billet is ground to remove surface defects, so grinding should be legal.)
6. The ball is polished through a lapping process. (Polishing and lapping should be legal since they are not deemed a fabrication technique in VUR3.)

Additionally, a ball bearing ball is "designed to be fabricated into something else" such as a linear slide, turntable, or gyroscope. It is not usable by itself in the same way a gear is.

With these rules and rulings in mind, is a ball bearing ball legal for use in VEXU?

Answered by Game Design Committee

Yes, ball bearing balls are legal. This was also clarified in this previous Q&A post:
<https://events.vex.com/VEXU/2022-2023/QA/1208>

1356: Is tape allowed to have less friction?

30-Dec-2022

VUR3 R10

Is it legal to use Scotch tape to cover sheets of plastic? The purpose would be to allow the discs to slide easier along the plastic. R10 states that tape can't be used in this way, but interpreting VUR3 e, attaching tape to the plastic falls under this rule.

Answered by Game Design Committee

Yes. This would be legal under rule <VUR3e>.

1301: VUR3 and VUR4 Differing Standards

16-Nov-2022

VUR3 VUR4

Thank you for your clarification in Q&A 1269! We have another follow up question about VUR3 and VUR4. Again, here are the rules:

VUR3:

Fabricated Parts may be made using the following processes: a. Adding material, such as 3D printing. b. Removing material, such as cutting, drilling, or machining. c. Bending material, such as sheet metal breaking or thermoforming. d. Casting or molding material, such as injection molding or sand casting. e. Attaching materials to one another, such as welding or chemically bonding (e.g., epoxy).

VUR4:

Fabricated Parts must be made from raw materials. For the purpose of this rule, a "raw material" is any material that would not be considered a "pre-fabricated" part (i.e., has not undergone any of the fabrication techniques listed in VUR3). a. Standard raw material finishing processes, such as extrusion, heat treating, or anodizing, are not considered pre-fabrication.

To summarize these two rules, fabricated parts are additively or subtractively manufactured, formed, cast, or attached together. Raw materials are materials that have not undergone these processes.

The problem is, by a literal reading of the rules, basically nothing is a raw material. Materials such as 3D printer filament, plastic sheets, and metal billets, despite meeting the common sense definition of a raw material, have all undergone some of the manufacturing processes listed in VUR3 and should therefore not be considered raw materials by the written rule.

To solve this problem, the GDC has introduced 3 new standards to determine whether a part is considered a raw material. Sometimes the standard is the [part's primary fabrication process](#), sometimes the standard is the [part's finishing process](#), and sometimes the standard is the [intention of the vendor who sold the part](#).

Each standard is fine on its own, but they are often in conflict with each other. When this happens, it's not clear when to apply which standard. We hope the GDC considers rewriting this rule in the future to make it less confusing. However, until then, we hope to gain some clarification by asking about a few specific parts. We have intentionally selected edge cases because we want to understand when to apply each standard.

1.) Are rubber bands that are not size 32 or 64 raw materials? Rubber bands are usually extruded and cut to length, which should make them raw materials by Q&A 1144, but they are also "intended to be used in the exact state in which it is (they are) sold & purchased," which should make them prefabricated by Q&A 1269.

If they are raw materials, how does that square with Q&A 1269, and if not, how does that square with Q&A 1144?

2.) Is gear stock a raw material? Many suppliers cast and heat treat their gear stock, and intend for it to be cut (subtractively manufactured) by the user, which should make it a raw material by Q&A 1235 and 1269. However, it seems like common sense that gear stock and normal gears are equally prefabricated / raw since the manufacturing processes and final geometry are very similar.

If gear stock is not a raw material, how does that square with Q&A 1235 and 1269?

3.) Is colored tape legal? In tape manufacturing, the backing and the glue of tape are attached together, which should make it a prefabricated part by VUR3 note e. Then the tape is dyed, which is a standard material finishing process and should make the tape a raw material by Q&A 1235. And, like an aluminum billet, tape is intended to be cut (subtractively manufactured) before use, so it should be a raw material (or at least shouldn't be disqualified from being a raw material) by Q&A 1269.

If colored tape is a raw material, how does that square with VUR3 note e? If not, how does that square with Q&A 1235?

Thank you for your time, and for your patience :) We know that these edge-cases are difficult to formalize rules around, and we appreciate your clarification and professionalism.

Answered by Game Design Committee

Thank you for your questions.

1.) Are rubber bands that are not size 32 or 64 raw materials?

Acceptable usage of rubber bands is covered by rule <R7h>, unless you wish to fabricate your own rubber bands as permitted under rule <VUR3>.

2.) Is gear stock a raw material?

Commercial off-the-shelf gears are not allowed for use on VEX U Robots, which we believe is the question you're actually asking here and the one we're able to provide a definitive answer for.

Team-fabricated gears, machined from raw steel / aluminum round stock, would be legal.

3.) Is colored tape legal?

Acceptable usage of tape is covered by rules <R7f> and <R10>, unless you wish to fabricate your own tape as permitted under rule <VUR3>.

Generally speaking, we try to refrain from extending the logic of one rule into another. However, we believe that the red box note for rule <R11> is also pertinent to your string of questions regarding rules <VUR3> and <VUR4>, so we'll extend it here: If a key component of your Robot's design relies upon convincing an inspector that a specific material or part is "technically not prefabricated" or "technically a raw material," it is probably outside of the spirit and intent of these rules.

Thank you for your patience. Edge cases are, as you've stated, difficult to formalize rules around.

1148: Carbon Fiber

6-Jul-2022

VUR3 VUR4

VUR3 states:

Fabricated Parts may be made using the following processes:

a. Adding material, such as 3D printing.

- b. Removing material, such as cutting, drilling, or machining.
- c. Bending material, such as sheet metal breaking or thermoforming.
- d. Casting or molding material, such as injection molding or sand casting.
- e. Attaching materials to one another, such as welding or chemically bonding (e.g., epoxy).

VUR4 states:

Fabricated Parts must be made from raw materials. For the purpose of this rule, a “raw material” is any material that would not be considered a “pre-fabricated” part (i.e., has not undergone any of the fabrication techniques listed in VUR3).

a. Standard raw material finishing processes, such as extrusion, heat treating, or anodizing, are not considered pre-fabrication.

b. Fabricated Parts may not be made from raw materials which pose a safety or damage risk to the event, other Teams, Field Elements, or Discs. Examples of prohibited materials include, but are not limited to:

- i. Any material intended to produce flames or pyrotechnic effects.
- ii. Any material that is liquid at the time of the Match (e.g., hydraulic fluids, oils, liquid mercury, tire sealant, etc.).

1. Fabrication processes that include the use of liquids, such as milling coolant or resin which has been cast into a solid part, are not considered a Violation of this rule.

Is carbon fiber stock a legal raw material under VUR4? Here are a couple examples of commonly available carbon fiber stock:

<https://www.mcmaster.com/5287T78/>

<https://www.mcmaster.com/8194K111/>

Given that the team performs one or more of the manufacturing processes in VUR3 in order to turn the raw carbon fiber into a Fabricated Part, would it be legal for use?

Answered by Game Design Committee

VUR4 does not include a specific list of permitted or prohibited materials, other than point "b" (i.e. the materials do not pose any safety or damage risks to the event).

So, in general, the use of carbon fiber is not prohibited as a blanket rule, but we would *strongly* advise researching any applicable safety precautions and protocols involved, and including these as part of a Team's VUR5 documentation (as should be done when working with any exotic materials).

Ultimately, the decision whether a given material poses a safety risk is at the discretion of the Head Referee and the Event Partner, taking into account the context of the material's usage and application. For example, we would not recommend using carbon fiber for a Fabricated Part that has a high likelihood of snapping during a match, or require additional drilling / cutting in the pit areas (i.e. around other Teams who may not be familiar with proper safety precautions involved).