Tentative Agenda
Municipal Committee
May 17, 2016
6:00 p.m.
City Hall Conference Room

Roll Call

DISCUSSION ITEMS

1) EMS Ambulance Chassis
   Doug Jonesi, Director of Emergency Medical Services

2) EMS Ambulance Coach
   Doug Jonesi, Director of Emergency Medical Services

3) EMS Ambulance Stryker Power Load
   Doug Jonesi, Director of Emergency Medical Services

4) EMS Roof Repairs
   Kati Horner Gonzalez, Acting Director of Public Works

5) Root Control Project
   Kati Horner Gonzalez, Acting Director of Public Works

6) Updates
   a. Emergency Storm Sewer Repairs at Elm & Crescent
   b. Grant Projects Design Progress

7) Next Meeting Date and Time – June 21, 2016 at 6:00 p.m.

Adjournment

Future Topics

- HVAC Replacement Project
- 59th Street Sidewalk
- Blue Ridge Resurfacing Project
- 350 & Raytown Road Improvements

CITY OF RAYTOWN
Request for Board Action

Date: 17 May 2016 **Resolution No.: R-XXXX-XX**
To: Mayor and Board of Aldermen
From: EMS, Doug Jonesi, Director

Department Head Approval: _____

Finance Director Approval: _____(only if funding requested)

City Administrator Approval: _____

Action Requested: Authorize and approve the purchase of a new cutaway Ford van chassis from Dick Smith Ford, to be delivered to Osage Ambulance/Emergency Services Supply for conversion into an ambulance. Cost is $28,167.00, and is part of a cooperative bidding situation.

Recommendation: Approve the request as submitted.

Analysis: Based on evaluation of historical data, patterns of use, and industry trends, Public Works/Fleet Services has determined an optimum replacement schedule for Raytown EMS' ambulances in order to maximize useful life of the equipment and to obtain the greatest economy of operation and maintenance. This purchase represents the third new ambulance in the 12-year cycle. It is to replace the oldest unit in our fleet of ambulances; the unit to be replaced is approaching the 110,000 mile mark, and it is the second chassis to be mounted under that particular coach. The chassis cost is $28,167.00; it has been budgeted, and the Sales Tax Oversight Committee has reviewed the project and found it to be within the intent of the Capital Sales Tax.

Alternatives: Not approve the request.

Budgetary Impact:

☐ Not Applicable
X Budgeted item with available funds
☐ Non-Budgeted item with available funds through prioritization
☐ Non-Budgeted item with additional funds requested

Amount Requested:	$28,167.00
Account Number(s):	
Fund:	Capital Sales Tax
Department:	Emergency Services
City Program:	
Department Program:	
Object Code:	

The amount budgeted for fiscal year 2015-2016 is $28,167.00.

Additional Reports Attached: Quote and cooperative bid documents for chassis.

2016 ECONOLINE

Order No: 6500 Priority: E1 Ord FIN: QQ933 Order Type: 5B Price Level: 640
Ord PEP: 782A Cust/Flt Name: RAYTOWN, MO PO Number:

		RETAIL	DLR INV			RETAIL	DLR INV
E4F	COM CUTAWAY VAN	$32005	$29684.00	18A	EXT UPGRADE PKG	$105	$94.00
	176" WHEELBASE				.CHROME BUMPERS		
PQ	RACE RED			21A	CPTNS CHRS DUAL	95	86.00
M	CLOTH CPTS CHRS	NC	NC	903	PWR WINDOWS/LKS	465	420.00
E	MEDIUM FLINT			552	CUTAWAY INSULAT	85	77.00
782A	PREF EQUIP PKG			15T	TRACTION CONTRL	225	203.00
	.STANDARD TRIM			162	FLR VINYL, FRT		
587	.ELEC AM/FM CLK			20F	14500# GVWR	NC	NC
593	.LT/CONVEN GRP						
596	.AIR BAG/PASS-2D			TOTAL	BASE AND OPTIONS	37850	34608.54
	.INSTR CLUSTER			TOTAL		37850	34608.54
646	.16" WHITE WHLS			*THIS IS NOT AN INVOICE*			
99S	6.8L EFI V10ENG	1050	949.00				
44P	ELEC 6-SPD AUTO			* MORE ORDER INFO NEXT PAGE *			
T67	.LT225/75RX16E B						

2016 ECONOLINE

Order No: 6500 Priority: E1 Ord FIN: QQ933 Order Type: 5B Price Level: 640
Ord PEP: 782A Cust/Flt Name: RAYTOWN, MO PO Number:

		RETAIL	DLR INV			RETAIL	DLR INV
41H	ENG BLK HEATER	$75	$68.00	63G	EXT HVY DUTY 78	NC	NC
425	50 STATE EMISS	NC	NC	656	FUEL TANK 55 GL		
47A	AMBUL PREP PKG	1910	1724.00	942	DAYTIME LIGHTS	45	40.00
	.4.56 LS XF3			948	KEYLESS/ALARM	225	203.00
	.FRT LICENSE BKT				SP FLT ACCT CR		(461.00)
	.SPARE TIRE/WHL				FUEL CHARGE		12.54
	.FRAME PUCKS				PRICED DORA	NC	NC
	.EXT HD 225-AMP				DEST AND DELIV	995	995.00
	.BATTERIES-DUAL						
	.FRT MAX GAWR			TOTAL	BASE AND OPTIONS	37850	34608.54
52S	USER SWITCHES	85	77.00	TOTAL		37850	34608.54
525	CRUISE CONTROL	240	216.00	*THIS IS NOT AN INVOICE*			
54E	MIRRORS,TRL TOW	230	208.00				
57X	AUX HTR-A/C CON	15	13.00				
625	RRVIEW MIRROR	NC	NC				

$ 28,167 each

Doug Lofton
Dick Smith Ford
816-353-1495

Teresa Henry

From: Greg Lofton <glofton@dicksmithford.com>
Sent: Thursday, March 10, 2016 9:05 PM
To: Tony Mesa; Doug Jonesi
Subject: 2016/17 F450 for Ambulance
Attachments: sharp@dicksmithford.com_20160310_214128.pdf

Gentlemen,
See the attached pricing for a 2016 F450 with Ambulance package per your specs from last year. Ford will price protect a 2017 order at the 2016 Bid prices. If any questions, let me know.

Thank you,

Greg Lofton
Dick Smith Ford Fleet/Commercial Manager
9505 E. State Route 350
Raytown, MO 64133
Office: (816) 353-1495
Cell: (913) 963-4460

CNGP530 VEHICLE ORDER CONFIRMATION 03/10/16 21:43:05

==> Dealer: F53013

2016 ECONOLINE Page: 1 of 2

Order No: 6500 Priority: E1 Ord FIN: QQ933 Order Type: 5B Price Level: 640

Ord PEP: 782A Cust/Flt Name: RAYTOWN, MO PO Number:

		RETAIL	DLR INV			RETAIL	DLR INV
E4F	COM CUTAWAY VAN	$32005	$29684.00	18A	EXT UPGRADE PKG	$105	$94.00
	176" WHEELBASE				.CHROME BUMPERS		
PQ	RACE RED			21A	CPTNS CHRS DUAL	95	86.00
M	CLOTH CPTS CHRS	NC	NC	903	PWR WINDOWS/LKS	465	420.00
E	MEDIUM FLINT			552	CUTAWAY INSULAT	85	77.00
782A	PREF EQUIP PKG			15T	TRACTION CONTRL	225	203.00
	.STANDARD TRIM			162	FLR VINYL, FRT		
587	.ELEC AM/FM CLK			20F	14500# GVWR	NC	NC
593	.LT/CONVEN GRP						
596	.AIR BAG/PASS-2D			TOTAL	BASE AND OPTIONS	37850	34608.54
	.INSTR CLUSTER			TOTAL		37850	34608.54
646	.16" WHITE WHLS			*THIS IS NOT AN INVOICE*			
99S	6.8L EFI V10ENG	1050	949.00				
44P	ELEC 6-SPD AUTO			* MORE ORDER INFO NEXT PAGE *			
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2016 ECONOLINE Page: 2 of 2

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	.4.56 LS XF3			948	KEYLESS/ALARM	225	203.00
	.FRT LICENSE BKT				SP FLT ACCT CR		(461.00)
	.SPARE TIRE/WHL				FUEL CHARGE		12.54
	.FRAME PUCKS				PRICED DORA	NC	NC
	.EXT HD 225-AMP				DEST AND DELIV	995	995.00
	.BATTERIES-DUAL						
	.FRT MAX GAWR			TOTAL	BASE AND OPTIONS	37850	34608.54
52S	USER SWITCHES	85	77.00	TOTAL		37850	34608.54
525	CRUISE CONTROL	240	216.00	*THIS IS NOT AN INVOICE*			
54E	MIRRORS,TRL TOW	230	208.00				
57X	AUX HTR-A/C CON	15	13.00				
625	RRVIEW MIRROR	NC	NC				

$ 28,167 each

Doug Lofton
Dick Smith Ford
816-353-1495

CITY OF INDEPENDENCE, MISSOURI
NOTICE OF RENEWAL
Vehicles – 2016 Model 251-14-7

Date: October 29, 2014 **Phone:** 816-353-1495

Vendor: 24462
Dick Smith Ford
9505 E 350 Highway
Raytown, MO 64133

Fax: 816-358-4406
E-Mail: glofton@dicksmithford.com
Contact: Greg Lofton
Title: Fleet Manager

Price Agreement Period: **11/1/2015 — 10/31/2016**

Renewal Options: Final year.

Status of Certificates: *Please remember to keep your certificates current*

Insurance N/A

Occupation License N/A

Vehicle Item Numbers: **1, 2, 3, 4, 10, 12, 13, 15, 16, 17, 18, 21, 22, 23, 24, 25, 26, 27, 28, 34, 35, 37, 39, 41, 42, 44**
Added in 2015: 21-2015, 26-2015, 28-2015
F.O.B: 1 Vehicle: $0.70/mile over 25 miles
3 or more vehicles: $0.10/mile over 25 miles

(Vehicles Model Year 2016) Mid-America Council of Public Procurement Joint Bid
Lead Agency: City of Independence

Detailed Specifications are located at: www.macpp.org

Tom Conrow

Tom Conrow, Procurement Specialist, (816) 325-7092

Russell M. Pankey, Purchasing Manager
Finance Department, Purchasing Division

Using Departments: **All Departments**
Cooperative
File

CITY OF RAYTOWN
Request for Board Action

Date: 17 May 2016 **Resolution No.: R-XXXX-XX**
To: Mayor and Board of Aldermen
From: EMS, Doug Jonesi, Director

Department Head Approval: _____

Finance Director Approval: _____(only if funding requested)

City Administrator Approval: _____

Action Requested: Authorize and approve the purchase of a new ambulance conversion from Osage Ambulance/Emergency Services Supply, to be mounted on the new chassis from Dick Smith Ford. The cost is $109,575.00, and is part of a cooperative bidding situation.

Recommendation: Approve the request as submitted.

Analysis: Based on evaluation of historical data, patterns of use, and industry trends, Public Works/Fleet Services has determined an optimum replacement schedule for Raytown EMS' ambulances in order to maximize useful life of the equipment and to obtain the greatest economy of operation and maintenance. This purchase represents the third new ambulance in the 12-year cycle. It is to replace the oldest unit in our fleet of ambulances; the unit to be replaced – a 2009 Taylor Made remount -- is approaching the 100,000 mile mark, and it is the second chassis to be mounted under this particular coach. The conversion cost is $109,575.00; it has been budgeted, and the Sales Tax Oversight Committee has reviewed the project and found it to be within the intent of the Capital Sales Tax.

Alternatives: Not approve the request.

Budgetary Impact:

☐ Not Applicable
X Budgeted item with available funds
☐ Non-Budgeted item with available funds through prioritization
☐ Non-Budgeted item with additional funds requested

Amount Requested:	$109,575.00
Account Number(s):	
Fund:	Capital Sales Tax
Department:	Emergency Services
City Program:	
Department Program:	
Object Code:	

The amount budgeted for fiscal year 2015-2016 is $109,575.00.

Additional Reports Attached: Quote and cooperative bid documents for ambulance conversion.
Vehicle Replacement Plan from Fleet

194 Twin Ridge Road
Linn, MO
Phone: 800/822-3634
Fax: 573/897-3113

DATE:	4/13/16
QUOTATION TO:	Raytown Emergency Medical Services
DELIVERY TIME:	Current Delivery slots in Dec 16
F.O.B.:	Linn, Missouri - Customer pick up of ambulance from Osage Industries.
PAYMENT:	Net on completion of work.

(1) New Type III modular ambulance with a 2017 Ford E450, Deluxe series, 158" wheelbase, dual rear wheel chassis as listed herein;

Customer Supplied Ford E450 Chassis Race Red in color
Customer supplied Stryker power load system
Customer Supplied opticom

Options added to unit
Plexi glass insert on front bulkhead cabinet
Domedic refrigerator in lower ALS
Shelf for autopulse with inside and outside access
No counter in monitor area
Door unlock added to rear of the truck

TOTAL PRICE AS LISTED HEREIN - - - - - - - - - - - - - - $ 109,575

Dan Kehoe
Emergency Services Supply

Quote valid for 30 days without review

Public Works Department
10000 East 59th Street
Raytown, Missouri 64133
(816) 737-6012
www.raytown.mo.us

Ambulance replacement schedule

The City of Raytown owns and maintains three ambulances that are operated by the EMS department for the good of the community. Two of the ambulances are in service 24/7 and the third is a relief or back up ambulance to be used when an ambulance is in for service or in the event of a mass casualty situation.

The ambulance fleet represents a substantial investment and as such requires an ongoing commitment to maintenance, and a plan for replacement based on an evaluation of the historical information, current use, trends in the industry and the needs of the community.

The replacement schedule of an ambulance must include factors such as the durability of the coach and the useful life expectancy of the chassis. An ambulance platform that experiences continuous expensive breakdowns or damaged beyond repair by crash will need to be replaced on an as needed and funded basis.

The body/coach shall have a minimum life expectancy so as to allow for at least one remount/refurbish onto a new chassis. The remounting of the body to a new chassis will generally represent a 30% savings over the cost of a complete comparable unit.

The life cycle of the chassis shall be 6 years or 150,000 miles whichever occurs first for light duty class IV truck/van chassis.

The expected life cycle of the ambulance body (the coach) shall be 12 years.

When an ambulance is purchased new and complete (chassis and coach body together) this will begin the replacement clock. The newest ambulance will be the lead ambulance (301), and the second oldest ambulance will be (302) and the third ambulance (303) will be the highest mileage and oldest ambulance in the fleet.

The newest ambulance will serve 2 years as the lead unit and historically will travel the most miles. (30,000 per year)

The second oldest ambulance will serve in this position for years 3 and 4 of the life cycle and travel similar miles.
(25,000 per year)

Public Works Department

10000 East 59th Street
Raytown, Missouri 64133
(816) 737-6012
www.raytown.mo.us

The oldest/highest mileage ambulance will serve as the backup ambulance for years 5 and 6 of the life cycle traveling the least miles.
(5,000 to 10,000 per year)

Year 7 the oldest ambulance will be sent to a suitable vendor for refurbishing, repainting and remounting of the body (coach) on a new chassis. This will begin the second 6 years of the life cycle of the ambulance by returning to the primary role (301). The two trucks not refurbished or replaced will be cascaded down to be 302 and 303 respectively based on age and miles.

Year 9 the oldest ambulance will be sent to a suitable vendor for refurbishing, repainting and remounting of the body (coach) on a new chassis. This will begin the second 6 years of the life cycle of the ambulance by returning to the primary role (301). The two trucks not refurbished or replaced will be cascaded down to be 302 and 303 respectively based on age and miles.

Year 11 the oldest ambulance will be sent to a suitable vendor for refurbishing, repainting and remounting of the body (coach) on a new chassis. This will begin the second 6 years of the life cycle of the ambulance by returning to the primary role (301). The two trucks not refurbished or replaced will be cascaded down to be 302 and 303 respectively based on age and miles.

Year 13 begins a new cycle with the purchase of a complete new ambulance (chassis and coach). With the purchase of the new coach the so begins the 12 year life cycle of the body (coach) and the 6 year life cycle of the chassis.

CITY OF RAYTOWN
Request for Board Action

Date: 17 May 2016 **Resolution No.: R-XXXX-XX**
To: Mayor and Board of Aldermen
From: EMS, Doug Jonesi, Emergency Medical Services Director

Department Head Approval: _____

Finance Director Approval: _____(only if funding requested)

City Administrator Approval: _____

Action Requested: EMS requests the Board of Aldermen to approve a resolution authorizing the purchase of a Stryker Power-LOAD system, to be installed on the ambulance which is currently to be ordered and delivered later in 2016.

Recommendation: The Department of Emergency Medical Services recommends the purchase and installation of this equipment.

Analysis: The Power-LOAD cot fastener system compliments the Power-PRO ambulance cots we currently have in service. During loading into/unloading from the ambulance, the system supports the full weight of cot and patient, lifts/lowers the cot into/out of the ambulance mechanically, thereby minimizing the potential to drop the cot or patient during these operations, and eliminating the operator spinal loads which can lead to cumulative trauma. Cost includes freight, extended warranty/maintenance package (7-year), and the retrofit of one of our cots to be used with the system.

Alternatives: The alternative would be to not purchase the system.

Budgetary Impact:

☐ Not Applicable
☒ Budgeted item with available funds
☐ Non-Budgeted item with available funds through prioritization
☐ Non-Budgeted item with additional funds requested

Amount Requested: $28,608.12
Account Number(s): 205-72-00-100-53250
Fund: Capital Sales Tax
Department: EMS

Additional Reports Attached:
Quote from Stryker
Power-LOAD brochure
Sole-source documentation
Additional information on the biomechanics of back injuries

Comprehensive Quotation

Sales Account Manager
Todd Tibbetts
Todd.Tibbetts@stryker.com
Cell: 925-323-8136

Remit to:
P.O. Box 93308
Chicago, IL 60673-3308

End User Shipping Address
1153213
RAYTOWN EMS
10020 E 66TH TERRITORY
RAYTOWN, MO 64133

Shipping Address
1153213
RAYTOWN EMS
10020 E 66TH TERRITORY
RAYTOWN, MO 64133

Billing Address
1153213
RAYTOWN EMS
10020 E 66TH TERRITORY
RAYTOWN, MO 64133

Customer Contact	Ref Number	Date	PO Number	Reference Field	Quote Type
	4759421	03/09/2016	QUOTE		

Line #	Quantity	Item Description	Part #	Unit Price	Extended Price	Item Comments
1.00	**1**	**PowerLOAD**	**6390000000**	**$20,995.00**	**$20,995.00**	
		Options				
	1	PowerLOAD	6390000000	$20,995.00	$20,995.00	
	1	Standard Comp 6390 Power Load	6390026000			
	1	English Manual	6390600000			
	1	1 year parts, labor & travel	7777881660			
2.00	1	Protect Power-LOAD- 7year	77506001	$5,804.12	$5,804.12	
3.00	1	6506 PWRLD COMPAT UPGRADE KIT	6506700001	$1,499.00	$1,499.00	
4.00	1	ProCare Upgrade Charge	77100003	$310.00	$310.00	

Note:

Product Total	$28,608.12
Freight	$0.00
Tax	$0.00
Total Incl Tax & Freight	**$28,608.12**

Signature: _____ Title/Position: _____ Date: _____

Deal Consummation: This is a quote and not a commitment. This quote is subject to final credit, pricing, and documentation approval. Legal documentation must be signed before your equipment can be delivered. Documentation will be provided upon completion of our review process and your selection of a payment schedule.
Confidentiality Notice: Recipient will not disclose to any third party the terms of this quote or any other information, including any pricing or discounts, offered to be provided by Stryker to Recipient in connection with this quote, without Stryker's prior written approval, except as may be requested by law or by lawful order of any applicable government agency.
Terms: Net 30 Days. FOB origin. A copy of Stryker Medical's standard terms and conditions can be obtained by calling Stryker Medical's Customer Service at 1-800-STRYKER.
Cancellation and Return Policy: In the event of damaged or defective shipments, please notify Stryker within 30 days and we will remedy the situation. Cancellation of orders must be received 30 days prior to the agreed upon delivery date. If the order is cancelled within the 30 day window, a fee of 25% of the total purchase order price and return shipping charges will apply.

Teresa Henry

From: Tibbetts, Todd <Todd.Tibbetts@stryker.com>
Sent: Tuesday, April 19, 2016 1:52 PM
To: Doug Jonesi
Subject: RE: Our quote

Doug,

That quote is still valid. And it will be until the end of September.

I'll look for those meeting invites and I will certainly see you at both meetings.

Todd Tibbetts
Mid West Account Manager
Stryker EMS Equipment
601 W 112th st
Kansas City, MO
C: 925.323.8136
F: 816.817.1437
Todd.tibbetts@stryker.com
www.ems.stryker.com

CHECK OUT OUR LATEST PRODUCT RELEASE 'XPS'
A permanent bariatric solution that stays on your stretcher!

http://youtu.be/AveOKQsijrU

From: Doug Jonesi [mailto:dougj@raytown.mo.us]
Sent: Tuesday, April 19, 2016 12:53 PM
To: Tibbetts, Todd <Todd.Tibbetts@stryker.com>
Subject: Our quote

Hi, Todd!

I'm preparing the request for board action for the purchase of the Power Load system for which you provided me with a quote last month. Could you please send me something that indicates the quote is still valid? Also, please, sole sourcing information?

Also, there will be two meetings at which it would probably be very good if you could come for a demo: the first is Tuesday, 3 May 2016 at 5:30 p.m. at Raytown City Hall. The second will be two weeks later on the 17th. The first one is a committee meeting, the second one will be the legislative session at which the vote will be taken.

Please call me at 816.309.0620, and we can firm this up.

Thanks!

Douglas A. Jonesi, EMT-P, Director
City of Raytown, Missouri
Emergency Medical Services

816.737.6030
816.737.8801 fax

engageraytownmo.mindmixer.com

Join the conversation! Engage Raytown has arrived and we want to hear from you. This platform allows you to interact with our elected officials as well as our city staff.

From: Tibbetts, Todd [mailto:Todd.Tibbetts@stryker.com]
Sent: 09 March, 2016 15:42
To: Doug Jonesi
Subject: Stryker

Doug,

Attached is the pricing you requested. Please stay in touch. I'm just down the road if you need me.

Take care,

Todd Tibbetts
Mid West Account Manager
Stryker EMS Equipment
601 W 112th st
Kansas City, MO
C: 925.323.8136
F: 816.817.1437
Todd.tibbetts@stryker.com
www.ems.stryker.com

CHECK OUT OUR LATEST PRODUCT RELEASE 'XPS'
A permanent bariatric solution that stays on your stretcher!

http://youtu.be/AveOKQsijrU

stryker

A typical strain injury has a total cost of **$70,408** to a department ($33,528 direct and $36,880 indirect costs)[4]

69% of the U.S. adult population is overweight[1]

The average age of an EMS worker is **40 years old**[2]

Low back strain was the cause of **78%** of compensation days in the U.S.[5]

1 in 4 EMS workers suffers a career-ending back injury within the first four years of employment.[6]

Lifting causes more than **70%** of back injuries for EMTs[3]

Did you **know?**

The statistics can be overwhelming. Stryker has [PROVEN] solutions to help your team fight early retirement.[6,7]

References

1. http://www.cdc.gov/nchs/fastats/obesity-overweight.htm
2. http://www.ems1.com/ems-management/articles/1193622-EMS-recruitment-strategiesfor-managers/
3. http://www.emsworld.com/press_release/11360397/firefighter-invents-product-toreduce-back-injuries
4. https://www.osha.gov/dcsp/smallbusiness/safetypays/estimator.html
5. http://www.emsworld.com/press_release/11360397/firefighter-invents-product-toreduce-back-injuries
6. Sanders, Mick J. (2011) Mosby's Paramedic Textbook (4th ed., p. 36)
7. http://ems.stryker.com/ Stryker's Powered System shown to reduce back related injuries.

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ems.stryker.com

stryker®

EMS Equipment

Power-LOAD™
power-loading cot fastener system

Power-LOAD
power-loading cot fastener system

Shown with optional accessories.

Reduce the risk of injuries when loading and unloading cots

Lifts and lowers the cot into and out of the ambulance, reducing spinal loads and the risk of cumulative trauma injuries.

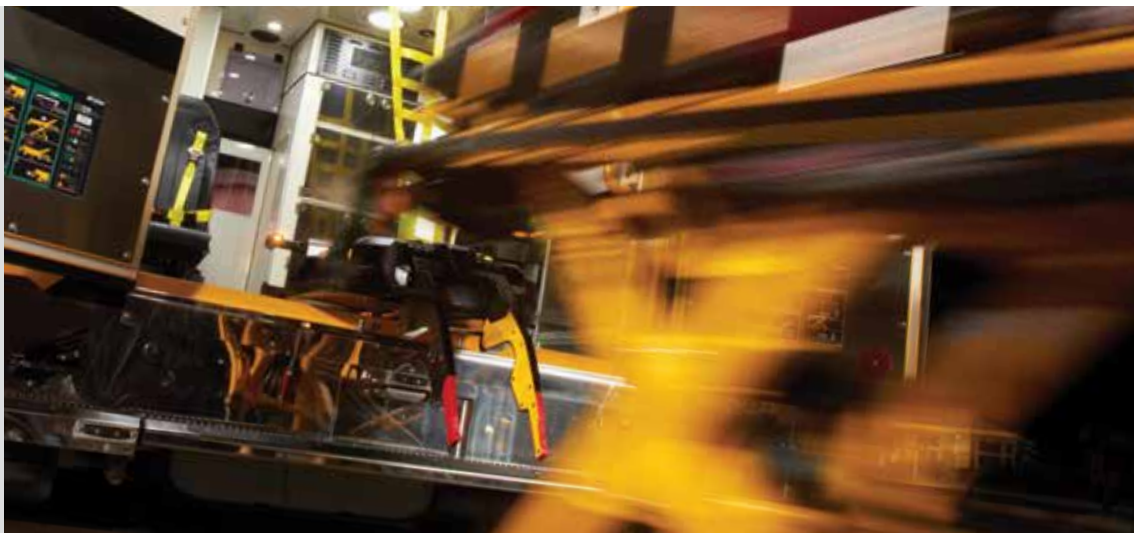
The Power-LOAD cot fastener system improves operator and patient safety by supporting the cot throughout the loading and unloading process. The reduction in spinal load helps prevent cumulative trauma injuries. Power-LOAD wirelessly communicates with Power-PRO™ cots for ease of operation and maximum operator convenience.

- **Eliminates the need to steer the cot into and out of the ambulance.**
- **Minimizes patient drops by supporting the cot until the wheels are on the ground.**
- **Meets dynamic crash test standards for maximized occupant safety.**
- **Features an easy-to-use manual back-up system, allowing complete operation in the event of power loss.**
- **Lifts or lowers the cot into and out of the ambulance, eliminating spinal loads that can result in cumulative trauma injuries.**

Power raise and lower for loading and unloading
using your finger, not your back.

Load and unload patients with the touch of a button.
Operator injuries result from repetitive spinal loading. Our innovative Power-LOAD cot fastener system is designed to load and unload a compatible cot with the touch of a button – not your back.

Save yourself from injury. Save your career with Power-LOAD.
Ergonomically designed to reduce operator and patient injuries, Power-LOAD hydraulically lifts patients weighing up to 700 lbs.



Cot Release Handles
Red release handles allow the cot to be disengaged from the Power-LOAD system when unloading.

Duplicate LED Indicator
Displays Power-LOAD status at the head end for added operator convenience.

Manual Trolley Release
Allows trolley to be released when locked at the head end.

Inductive Charging
Power-LOAD automatically charges the cot SMRT battery and Power-LOAD battery when in transport position (no cable or connectors required).

Head-end LED Indicators
Keeps operator informed of position status. Solid green when in position or ready to transport; flashing amber when not in position or not ready to transport.

Trolley
Secures the cot into the Power-LOAD system.

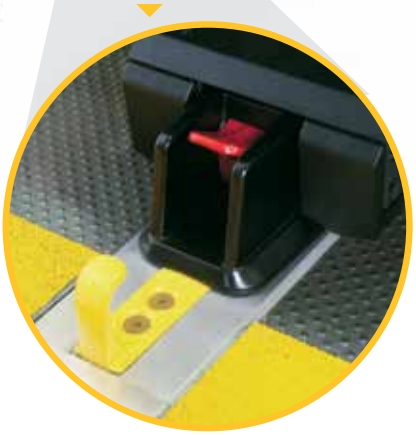
Lifting Arms
Battery-powered hydraulic lift system supports the cot and patient during loading and unloading.

Linear Transfer System
Supports and guides the cot during loading and unloading.

Control Panel
Allows complete operation for manual cots as well as the operation of powered cots in the event of a power loss.

Battery Indicator
If the Power-LOAD system is in transport position, the battery LED will flash green, indicating the battery is being charged. If the battery is low, the caution LED will flash amber.

Foot-end Release
Allows the cot to be disengaged from the patient compartment.



Safety Hook
Assures handling confidence when loading and unloading in the event of power loss.

700lb
capacity

Features

1 **Lifting Arms**
Battery-powered hydraulic lift system supports the cot and patient during loading and unloading.

2 **Head-end LED Indicators**
Keeps operator informed of position status. Solid green when in position or ready to transport, flashing amber when not in position or not ready to transport.

3 **Control Panel**
Allows complete operation for manual cots as well as the operation of powered cots in the event of a power loss.

4 **Cot Release Handles**
Red release handles allow the cot to be disengaged from the Power-LOAD system when unloading.

5 **Linear Transfer System**
Supports and guides the cot during loading and unloading.

6 **Inductive Charging**
Power-LOAD automatically charges the cot SMRT battery and Power-LOAD battery when in transport position (no cable or connectors required).

Inductive Charging
Power-LOAD automatically charges the SMRT battery when in transport position (no cable or connectors required).

Power Controls
The Power-PRO cot controls the Power-LOAD system during loading and unloading for ease of operation and maximum convenience.

Low Electrical Demand
Power-LOAD is self-powered, drawing minimal amperage from the vehicle (during charging process).

Operation Guide
Power-LOAD operation labels are provided and intended to be placed on the inside of the rear doors of the ambulance as a quick reference guide for Power-LOAD operation.

Control Panel
Allows complete operation for manual cots as well as the operation of powered cots in the event of a power loss.

Marine Grade Hydraulic System
Provides reliable operation in harsh conditions.

Warranty

- One-year parts, labor, and travel or two-year parts only
- Lifetime on all welds*

Extended warranties available.
*7-year service life

Certifications:
c UL us **IPX6** **AS/NZS 4535:1999** **IEC 60601-1** **BS EN 1789:2007**

MADE IN U.S.A.

Power-LOAD Cot Compatibilty

The Power-LOAD compatibility option is available for the Power-PRO XT, Power-PRO IT, and Performance-PRO. This system meets dynamic crash test standards for maximized occupant safety[1] and will automatically charge the Power-PRO XT and Power-PRO IT SMRT battery.

Power-PRO XT Ambulance Cot

Power-PRO IT Ambulance Cot

Performance-PRO XT Ambulance Cot

Optional Features

Wheel Guide
Required for applications when the Power-LOAD system is mounted near the wall. Keeps the wheels straight when loading and unloading.

Mass Casualty Floor Mount Assembly
Provides cot compatibility for non-upgraded Stryker X-frame cots. Assembly equipped with quick release mechanism for ease of operation.

Mass Casualty Wall Mount Assembly
Provides cot compatibility for non-upgraded Stryker X-frame cots. Assembly equipped with quick release mechanism for ease of operation.

Power-LOAD Specifications

Model Number	6390
Length	
Overall Length	95 in (241 cm)
Minimum Length	89.5 in (228 cm)
Width	24.5 in (62 cm)
Weight	
Total Weight	211.5 lb (96.5 kg)
Floor Plate Assembly	16.5 lb (7.5 kg)
Anchor Assembly	23 lb (10.5 kg)
Transfer Assembly	67 lb (30.5 kg)
Trolley Assembly	105 lb (48 kg)
Maximum Weight Capacity*	700 lb (318 kg)
Minimum Operator Required	
Occupied Cot	2
Unoccupied Cot	1
Recommended Loading Height	22 in to 36 in (56 cm to 91 cm)
Battery	12V, 5 Ah Lead Acid Battery (6390-001-468)

* Maximum weight capacity represents patient weight. Safe working load of 870 lb (395 kg) represents the sum of the cot total weight and patient.

† Meets dynamic crash standards for Power-PRO XT (AS/NZS-4535 and BS EN-1789) and Performance-PRO XT (BS EN-1789).

Stryker reserves the right to change specifications without notice.

Specifications are rounded to the nearest whole number. Conversions are calculated before rounding.

The Power-LOAD cot fastener system is designed to conform to the Federal Specification for the Star-of-Life Ambulance KKK-A-1822.

Patents pending.

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Date: April 29, 2013

Re: Power-LOAD Cot Fastener Sole Source Information

To Whom It May Concern:

Stryker Medical certifies that we are the sole manufacturer of the Stryker EMS Power-LOAD (Model 6390). This correspondence is to inform you of the unique characteristics of the Power-LOAD Cot Fastener. These characteristics can be broken down into two primary categories: Independent Qualification, and Ease of Use.

The Stryker EMS Power-LOAD (Model 6390) cot fastening system is mounted within the patient compartment and is intended to aid in the loading/unloading of patients. The Stryker Power-LOAD is the only powered cot fastening system that meets the following:

Independent Qualification

- IPX6: The system is rated to withstand powerful water jets.
- IEC 60601-1 and IEC 60601-1-2: This certification indicates that Power-LOAD conforms to industry standards for mechanical and electrical safety for medical electrical devices, as well as electromagnetic compatibility and immunity.
- BS EN-1789 clause 4.5.9: This is a European dynamic crash test which subjects a 50th percentile dummy to a nominal 10g deceleration for a minimum of 50ms. Following the test there shall be no sharp edges or danger to the safety of persons in the road ambulance.

Ease of Use

- Device must provide a linear guide when loading and unloading the cot
- Device must allow for remote actuation from Power-PRO foot end controls
- Device must engage to the cot during loading and unloading, providing a means of lifting and lowering
- Device must allow for manual back-up operation in the event of power failure or system error
- Device must have a safe working load of 870 lbs and be capable of lifting patients weighing up to 700lbs.
- Device must be mounted inside the patient compartment to prevent environmental exposure and corrosion
- Device must be power washable
- Device must be capable of inductively charging the Stryker SMRT cot battery

Please contact your Stryker Sales Representative for further information.

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ISB KEYNOTE LECTURE

THE BIOMECHANICS OF LOW BACK INJURY: IMPLICATIONS ON CURRENT PRACTICE IN INDUSTRY AND THE CLINIC

Stuart M. McGill

Occupational Biomechanics and Safety Laboratories, Department of Kinesiology, Faculty of Applied Health Sciences, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1

Abstract—The purpose of this paper is to introduce some concepts of low back injury for use towards developing better injury risk reduction strategies and advancing rehabilitation of the injured spine. Selected issues in low back injury are briefly reviewed and discussed, specifically, the types of tissue loads that cause low back injury, methods to investigate tissue loading, and issues which are important considerations when formulating injury avoidance strategies such as spine posture, and prolonged loading of tissues over time. Finally, some thoughts on current practice are expressed to stimulate discussion on directions for injury reduction efforts in the future, particularly, the way in which injuries are reported, the use of simple indices of risk such as load magnitude, assessment of the injury and development of injury avoidance strategies. This paper was written for a general biomechanics audience and not specifically for those who are spine specialists. © 1997 Elsevier Science Ltd. All rights reserved.

Keywords: Low back injury; Lumbar spine; Injury; Low back pain.

INTRODUCTION

What really causes low back injury? Why may only one individual become injured among a group of workers performing an identical job? How is it that a worker can perform a physically demanding job all day and then 'throw their back out' at night picking up a pencil? How does low back injury occur in people who perform seated-sedentary jobs? It is better to stoop or squat when lifting? Is compression that most important loading variable when considering injury? We have all experienced injury of various sorts throughout our lives, but why do we become injured at all? While it is currently popular to state that psychosocial components factor heavily in several aspects of occupational low back pain, there is no dispute that injury must result from excessive mechanical loading of a particular tissue, thereafter psychosocial aspects affect injury reporting, pain perception, etc. In fact, it is the characteristics of the load itself (load rate, mode of load compression, bending, torsion, shear, etc.) and properties of the tissue which determine the type and extent of tissue damage. Loads on individual tissues can be surprisingly high, in fact, given the magnitude of tissue loads during the performance of quite ordinary daily tasks, our enjoyment of lengthy periods free from injury fosters an appreciation for the magnificent strength and durability of the low back.

The purpose of this review paper is to introduce, and discuss in a limited way, some selected issues associated with low back injury. It is the opinion of this author that failure to recognize the intricacies of the biomechanics of low back injury is a serious impediment to the further development of strategies for significant reduction in occupationally related low back injury and also hinders major advances in rehabilitation of the injured spine. Combining biomechanical modelling techniques to obtain tissue loads with studies of tissue mechanics and structural architecture is a powerful approach for analysing injury mechanisms, assessing the injury risk, and preparing injury avoidance strategies.

THE INJURY PROCESS

While a generic scenario for injury is presented in this section, references for injury from repeated and prolonged loading to specific tissue is provided in the next section. The purpose here is to motivate consideration of the many factors which modulate the risk of tissue failure, and generate hypotheses to probe injury etiology.

Injury, or failure of a tissue, occurs when the applied load exceeds the failure tolerance or strength of the tissue. Injury shall be defined, for the purposes of this paper, as the full continuum from the most minor of tissue irritation (but micro-trauma nonetheless) through to the grossest of tissue failure, for example, vertebral fracture or ligament avulsion. Obviously, a load that exceeds the failure tolerance of the tissue, applied once, produces injury (the Canadian snowmobiler, airborne, and about to experience an axial impact with the spine fully flexed is at risk of, in this case, posterior disc herniation upon landing). This injury process is depicted in Fig. 1, where a margin of safety is observed in the first cycle of sub-failure load. In the second loading cycle, the applied load increases in magnitude, simultaneously decreasing the margin of safety to zero and injury occurs. While this description of low back injury is common, particularly amongst the medical community who are required to identify an event when completing injury reporting forms, it is the contention of this author that relatively few low back injuries occur in this manner. (More detail or the types of loads which create injury are noted in the next section).

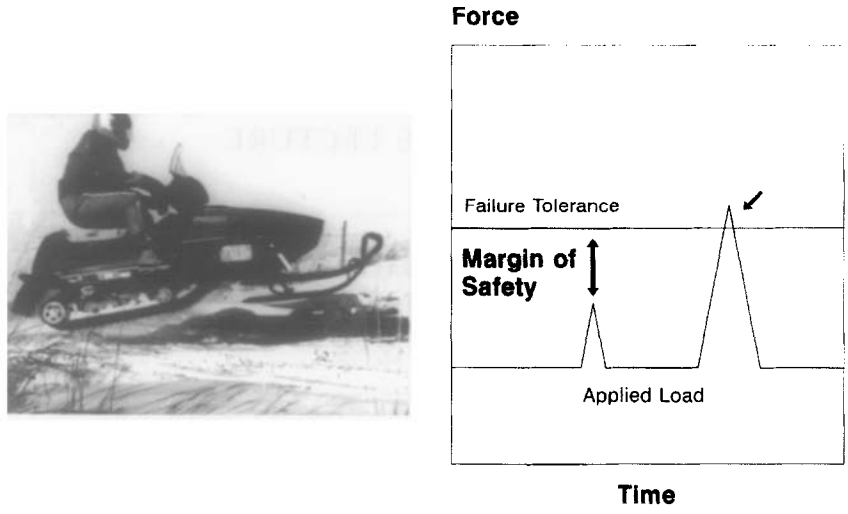

Fig. 1. The Canadian snowmobile driver (the author in this case who should know better) is about to experience an axial compressive impact load to a fully flexed spine—one-time application of load can reduce the margin of safety to zero as the applied load exceeds the strength or failure tolerance of the supporting tissues (shown with the small arrow).

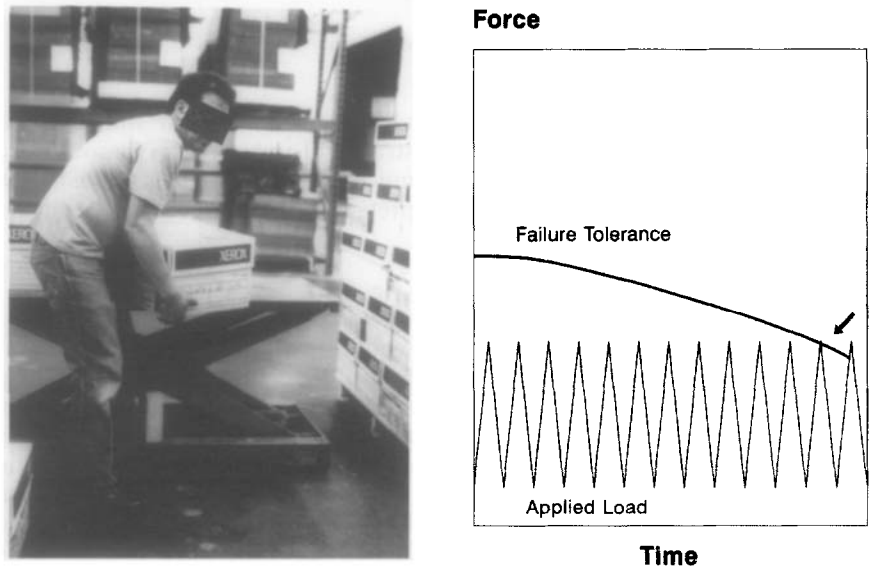

Fig. 2. Repeated sub-failure loads lead to tissue fatigue and failure on the Nth repetition of load (or box lift in this example).

There are more likely scenarios which result in injury, when considering occupational and athletic endeavours, which involve cumulative trauma from sub-failure magnitude loads. In such cases, injury is the result of accumulated trauma produced by either the repeated application of relatively low load or the application of a sustained load for a long duration (as in sitting for example). An individual is shown loading boxes on a pallet, repeatedly loading the tissues of the low back (several tissues could be at risk) to a sub-failure level (Fig. 2) causing a slow degradation of their failure tolerance (e.g. vertebrae—Brinckmann *et al.* (1989); disc—Adams and Hutton (1985)). As the margin of safety approaches zero, this individual will experience low back injury. Obviously, the accumulation of trauma is more rapid with higher loads (Carter and Hayes (1977) noted that, at least with bone, fatigue failure occurs with fewer repetitions when the applied load is closer to the yield strength).

Yet another way to produce injury with a sub-failure load is to induce stresses over a sustained period of time. The rodmen (shown in Fig. 3), with their spines fully flexed for a prolonged period of time are loading the posterior passive tissues and initiating changes in disc mechanics. The sustained load causes a progressive reduction in the margin of safety where injury is associated with the nth% of tissue strain. However, analysis of injury is further complicated by the interaction between the various tissues in the low back. For example, the prolonged–stooped posture loads the posterior ligaments of the spine and posterior fibres of the intervertebral disc causing creep deformation, possibly to the point of micro-failure (e.g. Adams *et al.*, 1980; McGill

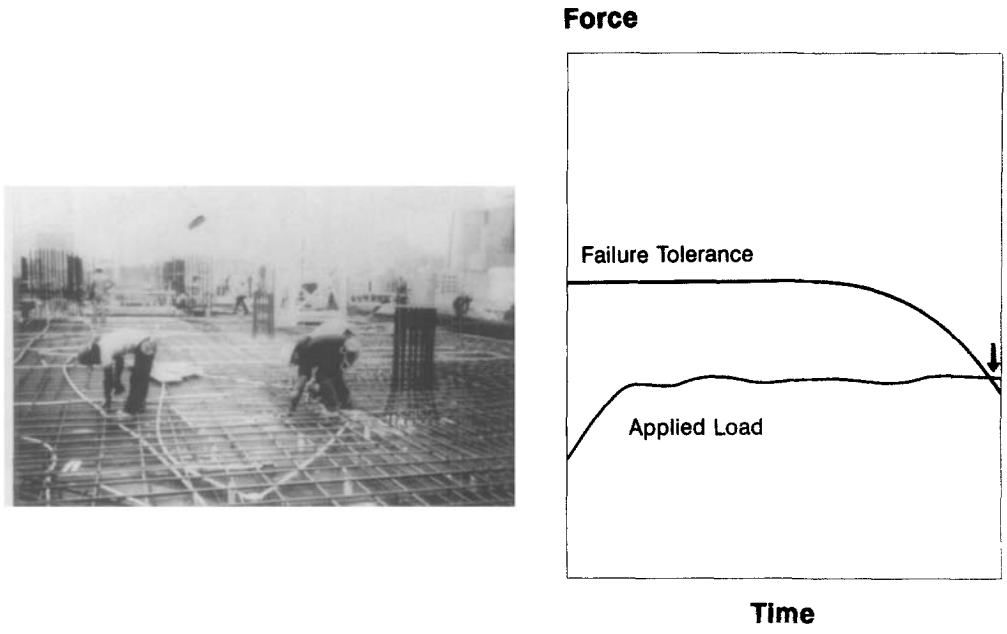

Fig. 3. These 'rodmen' are loading posterior passive tissues for a long duration which fail at the *N*th% of tissue strain. Strain progresses with time—steadily reducing the margin of safety.

and Brown, 1992). Quite possibly, the following chain of events may result: 'stretched' ligaments increase joint laxity, increasing the risk of hyper flexion injury (to the disc), and increasing the risk of local instability leading to injury of unisegmental structures, and ever increasing shearing and bending loads on the neural arch. It would appear that the most appropriate injury intervention strategies must appreciate the complexities of tissue overload.

The objective of injury avoidance strategies is to ensure that tissue adaption stimulated from exposure to load, it has to keep pace with and ideally exceed, the accumulated tissue damage. Thus, exposure to load is necessary but in the process of accumulating microtrauma, the applied loads must be removed to allow the healing-adaption process to gradually increase the failure tolerance to the necessary level. Tissue loading, and the risk of injury forms an optimum 'u' shaped relationship, where the determination of the safety optimum for individual tissue loading encompasses both the art and science of medicine and biomechanics.

In summary, the injury process need not only be associated with very high loads but rather, with relatively low loads that are repeated or sustained, justifying the need for rigorous examination of injury and tissue loading for substantial periods of time prior to the culminating injury event. It is important to recognize that simply focusing on a single variable such as one-time load magnitude may not result in a successful index of risk of injury, particularly across a wide variety of activities.

WHAT REALLY CAUSES INJURY?

Understanding the cause of injury is important for developing prevention strategies. While it is out of the scope of this paper, it is acknowledged that the etiology, pathogenesis and pathology that causes pain and impairment are highly linked together such that injury today changes the biomechanics and in fact the course of normal aging leading to 'degenerative' conditions later (Kirkaldy–Willis (1988) provides an excellent, if not older, review on this topic). The important point is that biomechanists must consider not only the application of the single load but repeated and prolonged loads to tissues that sometimes may be altered from previous load exposure and possible injury.

Vertebrae

Countless studies over the years have demonstrated that a neutral spine under compressive load results in bony failure (e.g. Brinckmann *et al.* (1989) provides a nice review)—specifically end plate fracture and damage to underlying trabeculae (e.g. Fyhrie and Schaffler, 1992) (Fig. 4)—and that repeated loading reduces the ultimate strength (Hansson *et al.*, 1987). Disc herniation is an extremely rare occurrence when the motion unit is compressed in a neutral posture. High-velocity compression results in often catastrophic vertebral burst fractures although this is not associated with occupational disorders (Adams and Dolan (1995) provide a nice review on this topic).

Disc herniation

Disc herniation from one-time application of load is extremely difficult to produce although it was achieved by Adams and Hutton (1982) with the application of compression to a spine deviated into hyperflexion and lateral bending. Herniation is more consistently produced under many cycles of combined compression, flexion and torsional loading (cf. Gordon *et al.*, 1991; Yang *et al.*, 1988) and tends to occur in younger specimens (cf. Adams and Hutton, 1985) with no visible gross signs of 'degeneration'. Epidemiological data also links herniation with

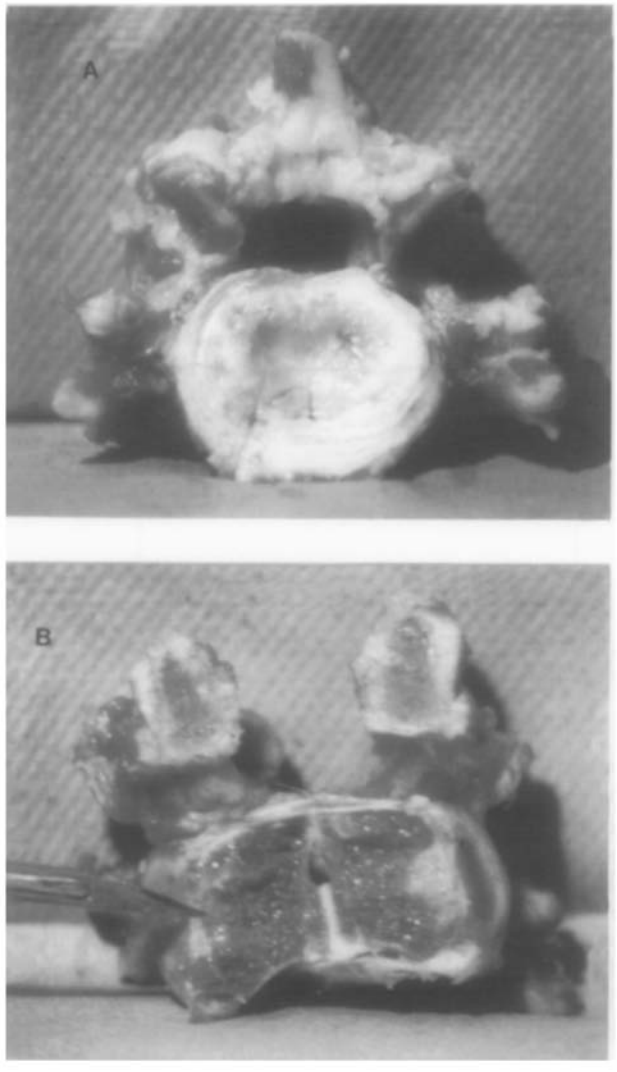

Fig. 4. End plate fracture (A) and intrusion of nuclear material (shown at the tip of the scalpal) into the vertebral body (B) from compressive loading of a spine in a neutral posture. These are porcine specimens from our laboratory.

Fig. 5. Longitudinal ligament avulsion from a flexion-shear test (shown at the tip of the scalpal) on a porcine specimen.

sedentary occupations and the sitting posture (Videman *et al.*, 1990). In fact, Wilder *et al.* (1988) documented annular tears in young calf spines from prolonged simulated sitting postures and cyclic compressive loading (e.g. truck driving environment). Older spines appear not to exhibit 'classic' extrusion of nuclear material but rather are characterized by delamination of the anulus layers, and radical cracks which appear to progress with repeated loading (e.g. Goel *et al.* (1995), provides a nice modelling and experimental review). In summary, it appears that disc herniation is the result of cyclic loading, or prolonged and sustained loading, in deviated spine postures. The notion that disc herniation in an occupational or athletic setting is the result of a single event appears unlikely.

Ligaments

A similarly interesting story unfolds with bony failure and ligamentous injury. King (1993) noted that soft tissue injuries are much more common during high-energy traumatic events such as automobile collision. Our own observations on pig and human specimens loaded at slow load rates in bending and shear, suggests that most frequently excessive tension in the longitudinal ligaments results in avulsion or bony failure as the ligament pulls some bone away near its attachment (see Fig. 5). Noyes *et al.* (1974) noted that slower strain rates (0.66% s^{-1}) produced more ligament avulsion injuries while faster strain rates (66% s^{-1}) resulted in more ligamentous failure to the fibre bundles (in the middle region of the ligament), at least in monkey knee ligaments. Similar observations were made by Yoganandan *et al.* (1989) on cervical spine ligaments loaded in pure tension at rates from 9 to 2260 mm s^{-1}. Yet it is interesting to note that in the clinical report by Rissanen (1960) that approximately 20% of cadaveric spines possessed visibly ruptured interspinous ligaments (in their middle, not at their bony attachment) and that dorsal and ventral positions, together with supraspinous, remained intact. Given the oblique fibre direction of the interspinous complex (see Fig. 6(B)), a very likely scenario to damage this ligament would be slipping and falling and landing on one's behind, driving the pelvis forward on impact, creating a posterior shearing of the lumbar joints when the spine is fully flexed. The interspinous is a major load bearing tissue in this example of high-energy loading where anterior shear displacement is combined with full flexion. Given the available data, it is the opinion of this author that torn ligaments of the spine during lifting or other normal occupational activities, particularly to the interspinous complex, is more uncommon than common. Rather, it appears much more likely that ligament damage occurs during a more traumatic event, particularly landing on one's bending during a fall, which then leads to joint laxity and acceleration of subsequent arthritic changes. As has been often said in reference to the knee, 'ligament damage marks the beginning of the end'.

Facets and neural arch

The facets and neural arch appear to withstand approximately 2000 N of shearing load (Cripton *et al.*, 1995) and fail under shear loading and torsional loading

and hyper extension (cf. Admas and Hutton, 1981). Epidemiologically, failure of the neural arch and pars interarticularis is common among athletes who rapidly cycle between flexion and extension suggesting strain reversals of the flexible arch promotes fatigue and eventually failure (cf. Hardcastle *et al.*, 1992; Wiltse *et al.*, 1975).

AN APPROACH TO INJURY ANALYSIS THAT IS SENSITIVE TO HUMAN VARIABILITY

The purpose of this section is to describe a specific modelling approach suited for analysis of injury. While several other approaches, such as finite element modelling and clinically based studies have provided many important insights, the author has chosen to focus on a specific approach in order to discuss some selected notions of low back injury addressed later in the manuscript.

There is tendency among biomechanists, and those responsible for reducing low back injury, to try to simplify the low back system and use various surrogates for tissue load to both quantify the risk of injury and evaluate potential solutions. No doubt determining tissue load–time histories constitutes a first-order approach to examine the risk of injury and to investigate low back mechanics—but it is the most difficult approach. Simply calculating a moment about the low back constitutes a second-order approach. While the moment indicates the general demand on the low back, it does not enable analysis of individual tissue injury since the moment is not partitioned among the various tissues and is not sensitive to other parameters which affect tissue load distribution such as joint position. Some have attempted to relate injury with surrogates such as posture, repetition and 'forcefulness', but these constitute a third-order of investigation as even more unknown factors modulate the risk of injury to each individual tissue. For this reason, to investigate the biomechanics of injury, our objective has been to use a first-order approach employing sophisticated modelling to obtain individual tissue loads and combine this knowledge with tissue experimentation.

There have been several simple modelling approaches used to estimate low back loading and to establish guidelines for maximum allowable loads in industry (NIOSH lifting guidelines for example) that have been reasonably successful in demonstrating the effects of body posture on an overall index of spine load such as low back compression. However, while such an approach may be useful for addressing the most overt of violations of biomechanical principles to reduce the risk of injury in industry, this approach does not elucidate how the spine works, does not identify the individual differences that lead some people to injury, does not address the many subtle mechanical characteristics of the spine that are important when considering injury. Deeper insight into the biomechanics of the low back is aided with a much more anatomically complex approach. The anatomical design of the various tissues of the low back contain many subtleties which work to support loads in a safe way but they may lead to tissue overload if the advantages in design go unrecognized. However, this complex approach introduces many unknown muscle, ligament, and other tissue forces, the number of which exceed the number of equilibrium equations necessary to solve for their force magnitudes. Two methods have been utilized to distribute forces among the many muscles; optimization and models driven from biological signals, both of which have unique assets and liabilities. The optimization approach utilizes a mathematical convergence algorithm that iterates through incremented muscle forces until a unique solution (or set of muscle forces) is produced that fulfils an objective function, for example, minimum compression of the intervertebral joint. In producing a unique solution, the mechanical constraints of the model are satisfied; in other words, the predicted muscle forces balance the reaction moments. Optimization approaches have been useful for systematically studying apparent muscle co-activation (Hughes *et al.*, 1995)—which in fact may not be co-activation at all during the support of three simultaneous moments about the several joints of the low back (e.g. Pope *et al.*, 1986; Stokes and Gardner-Morse, 1994). However, the same solution is predicted by the optimization approach for all conditions where the reaction moment is similar as the process is unable to distinguish between the many strategies of muscle recruitment that different people choose. Furthermore, many optimization criteria (at least linear criteria) rarely invoke the co-contraction forces in the antagonistic musculature acting about a lumbar joint (Hughes *et al.*, 1994). Therefore, while mathematical validity can be claimed by the optimization approach, biological validity is a concern—particularly when used to assess injury that results from the unique way that an individual moves or activates muscles leading to tissue overload. An alternative approach, and the one documented here, is to partition the reaction moments among the passive tissues (ligaments, disc, and other structures) and muscle based on biological signals are measured directly from the subject. For example, muscle forces are derived, in part, from activation levels measured from calibrated EMG (together with coefficients for muscle physiological cross-sectional area, stress, and instantaneous length and velocity) and the passive tissue forces are estimated from direct measures of calibrated joint angular position. In this way, the individual patterns of muscle recruitment and strategies of muscle–ligament interplay can be assessed per individual, and per task. While mathematical constraints are not always satisfied with the biological approach, and the fact remains that internal tissue force prediction can be problematic, one could argue for its suitability to assess individual injury (for a more complete discussion of the issue refer to Cholewicki *et al.*, 1995). The model of McGill and Norman (1986), which has been expanded to enable full three-dimensional analysis (McGill, 1992) more fully describes this approach to estimate tissue load time histories. Recent developments include improved abdominal architecture (McGill, 1996) and better prediction of the neural activation of deeper muscles such as psoas, quadratus lumborum and the three layers of the abdominal wall (McGill *et al.*, 1996a). While force–time histories of the individual tissues enable evaluation of injury mechanisms, the approach is limited to laboratory usage due to its very complex data collection requirements.

Over a series of experiments examining the mechanics of a variety of tasks, some generalizations can be made regarding the generation of three-dimensional moments about the low back and the resultant compressive loading of the lumbar spine. Equivalent compressive loads can be estimated about single axes using the following single equivalent moment arms to balance three-dimensional moments: extension 5–6.5 cm; flexion 4–4.5 cm; lateral bend 3–4 cm; axial twist 1–3 cm (McGill *et al.*, 1996b). The major reason for diminishing moment arms when generating moments other than extension (resulting in larger compressive penalties for the generation of a given moment) is the general increase in agonist–antagonist co-contraction (particularly for axial twist).

Our model output has enabled analysis of several issues, some of which are addressed in the following sections.

STOOP VS SQUAT LIFTING: DOES IT MATTER?

Let's revisit this old issue of lifting style. For many years, there has been an emphasis in industry to recommend that workers bend the knees and not the back (i.e. squat) when lifting. The fact that many workers prefer to stoop, may be due to the long recognized fact that there is an increased physiological cost in squatting (Garg and Herrin, 1979) and that relatively few jobs can be performed in this way. Several studies have attempted to evaluate the issue of stoop vs squat lifting postures based mostly on comparisons of low back compression but were unable to uncover a clear biomechanical rationale for the promotion of either. Perhaps the issue is much more complex than has been realized. From a tissue load distribution perspective, the following example demonstrates the shifts in tissue loading, predicted from our modelling approach, which has quite dramatic affects on shear loading of the intervertebral column. First, the dominant direction of the pars lumborum fibres of longissimus thoracis and iliocostalis lumborum are noted to act obliquely to the compressive axis of the lumbar spine producing a posterior shear force on the superior vertebra. In contrast, the interspinous ligament complex acts with the opposite obliquity to impose an anterior shear force on the superior vertebra (see Fig. 6). This is one example where spine posture determines the interplay between passive tissues and muscles which ultimately modulates the risk of several types of injury (see Marras *et al.*, 1995). For example, if a subject holds a load in the hands with the spine fully flexed sufficient to achieve myoelectric silence in the extensors (reducing their tension), and with all joints held still so that the low back moment remains the same, then the recruited ligaments appear to add to the anterior shear to levels well over 1000 N, which is of great concern from an injury risk viewpoint (see Fig. 7). However, a more neutral lordotic posture is adopted and the extensor musculature is responsible for creating the extensor moment and at the same time it will support the anterior shearing action of gravity on the upper body and hand-held load. Disabling the ligaments greatly reduces shear loading. Here is an example where the spine is at much greater risk of sustaining shear injury (> 1000 N) than compressive injury

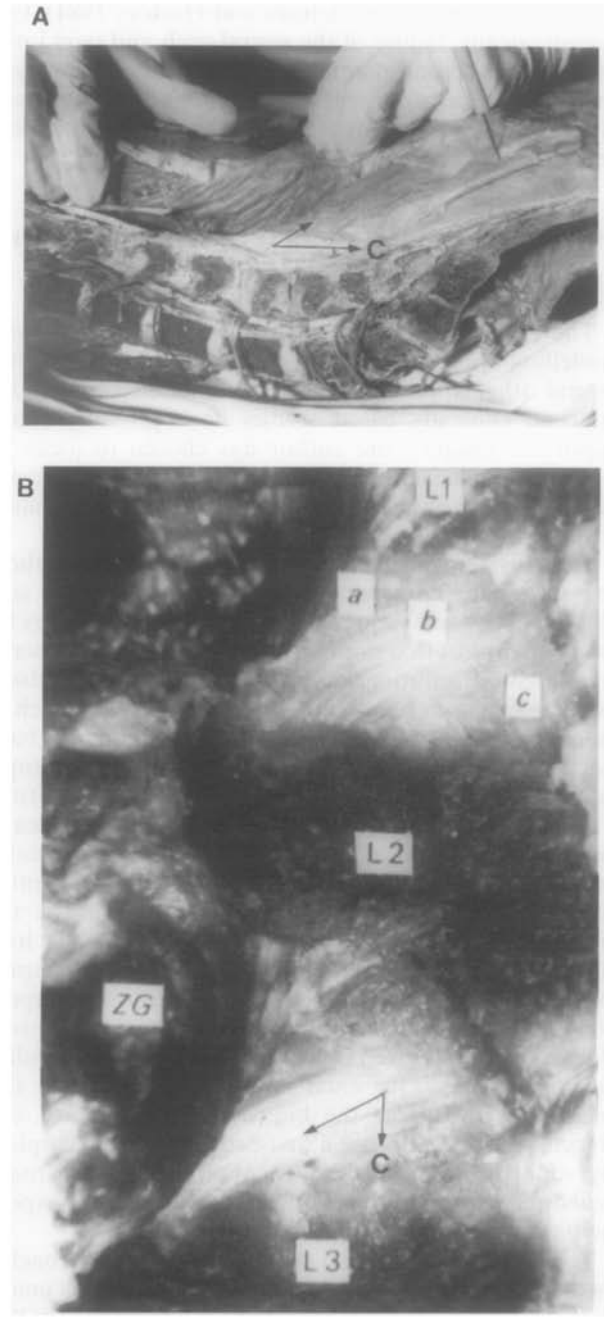

Fig. 6. (A) Pars lumborum fibres of iliocostalis lumborum and longissimus thoracis creates a posterior shear force on the superior vertebra while (B) in contrast the interspinous ligament imposes an anterior shear when strained in flexion (published with permission originally published in Heylings (1978)). The general oblique line of action of the muscle and ligament is shown compared to the compressive axis (c).

(3000 N) suggesting that compression, as an index of risk, was not the best choice of index.

The issue of whether to stoop or squat becomes much more complex when one considers the type of injury, the distribution of load among the tissues, and the modulation of failure tolerance as a function of spine posture. In fact, the case could be made that the important issue is not whether it is better to stoop lift or to squat lift but rather the emphasis could be placed on placing the load

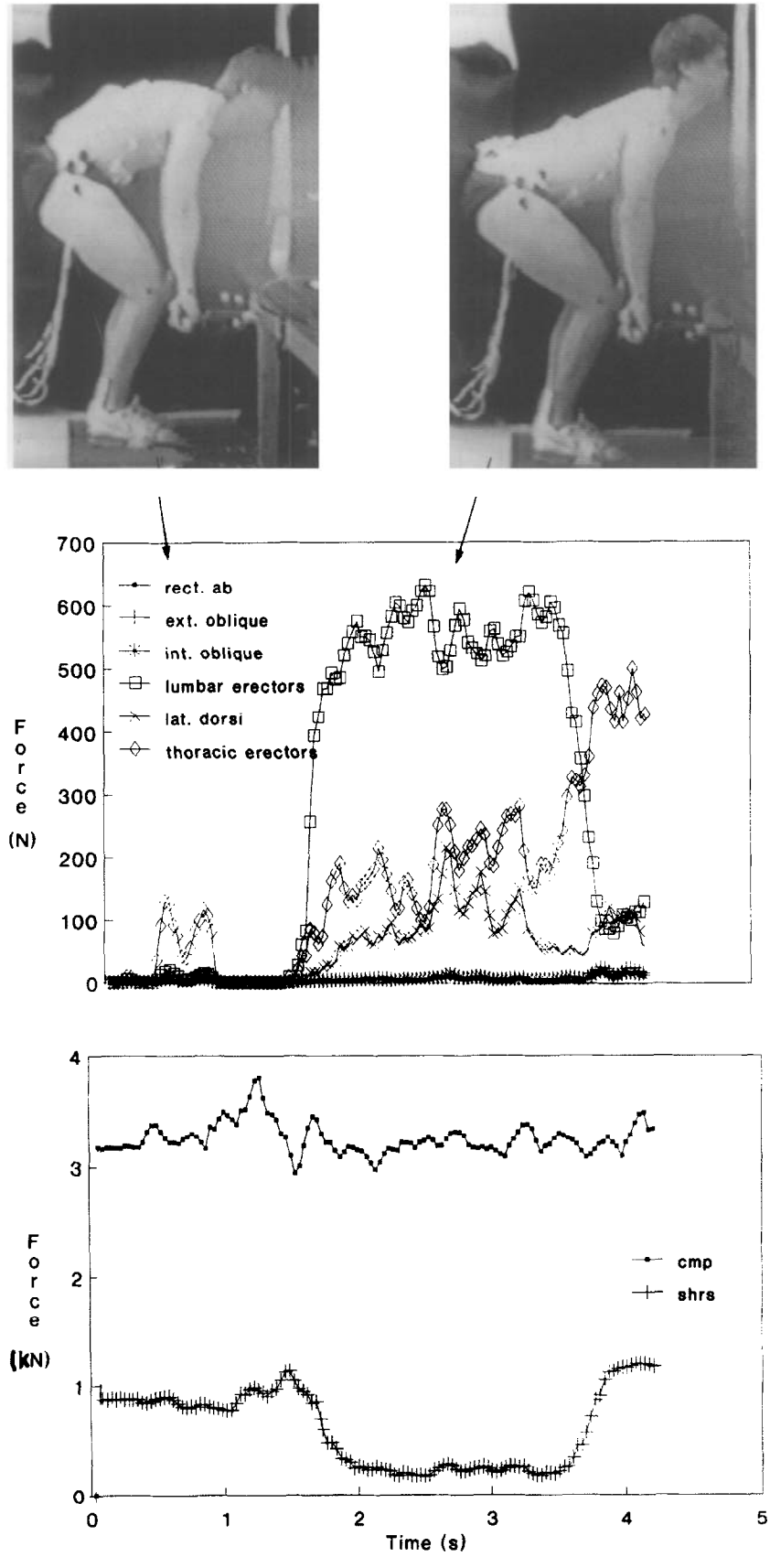

Fig. 7. The fully flexed spine is associated with myoelectric silence in the back extensors and loaded posterior passive tissues, and high shearing forces on the lumbar spine. A more neutral posture recruits the shear supporting pars lumborum extensors, disables the shear imposing interspinous ligaments, and reduces the net shear on the spine.

close to the body to reduce the reaction moment (and the subsequent extensor forces and resultant compressive joint loading) and to avoid a fully flexed spine to minimize shear loading. In fact, sometimes it may be better to squat to achieve this, or in cases where the object is too large to fit between the knees, it may be better to stoop, flexing at the hips but always avoiding full flexion to minimize posterior ligamentous involvement. (For a more comprehensive discussion see McGill and Norman (1987, 1988), Potvin *et al.* (1991) and McGill and Kippers (1994)).

MOTOR CONTROL CONSIDERATIONS AS A CAUSE OF INJURY

While injury from large exertions is understandable, explanation of how people injure their backs performing rather low load, benign appearing, tasks is more difficult—but the following is worth considering. The ability of the joints of the lumbar spine to bend in any direction is accomplished with large amounts of muscle co-contraction. Intuition would suggest that such co-activation patterns increase the compressive load penalty imposed on the spine when generating the torque necessary to support the upper body posture and external load. Perhaps the co-contracting muscles have another role. The lumbar ligamentous spine will fail under compressive loading in a buckling mode at about 90 N (Crisco *et al.*, 1992). The spine can be likened to a flexible rod—under compressive loading it will buckle. However, if guy wires are connected to the rod, like the rigging on a ships mast, the supporting wires add more compression but the rod is able to bear a much higher compressive load as it stiffens and becomes more resistant to buckling. A number of years ago, we were investigating the mechanics of power lifter's spines while they lifted extremely heavy loads using video fluoroscopy for a sagittal view of the lumbar spine (Cholewicki and McGill, 1992). The range of motion of the power lifter's spines were calibrated and normalized to full flexion by first asking them to flex at the waist and support the upper body against gravity with no load in the hands. During their lifts, although they outwardly appeared to have a very flexed spine, in fact, the lumbar joints were two to three degrees per joint from full flexion, explaining how they could lift such magnificent loads (up to 210 kg) without sustaining the injuries which we suspect are linked with full lumbar flexion. However, during the execution of a lift, one lifter reported discomfort and pain. Upon examination of the video-fluoroscopy records, one of the lumbar joints (specifically, the L4/L5 joint) reached the full flexion calibrated angle, while all other joints maintained their static position (2–3° from full flexion). This is the first observation that we know of reported in the scientific literature documenting proportionately more rotation occurring at a single lumbar joint, and it would appear that this unique occurrence was due to an inappropriate sequencing of muscle forces (or a temporary loss of motor control wisdom). This motivated the work of my colleague and former graduate student Jacek Cholewicki to investigate and continuously quantify stability of the lumbar spine throughout a reasonably wide variety of loading tasks (Cholewicki and McGill, 1996). Generally speaking, it appears that the occurrence of a motor control error which results in a temporary reduction in activation to one of the intersegmental muscles, perhaps for example a laminae of multifidus, could allow rotation at just a single joint to the point where passive, or other tissue, become irritated or even more traumatically injured. Cholewicki noted that the risk of such an event was greatest when there are high forces in the larger muscles with simultaneous low forces in the small intersegmental muscles (a possibility with our power lifter) or when all muscle forces are low such as during a low level exertion. Thus, a mechanism is proposed, based on motor control error resulting in temporary inappropriate neural drive, that explains how injury might occur during extremely low load situations, for example, picking a pencil up from the floor following a long day at work performing a very demanding job (see Fig. 8).

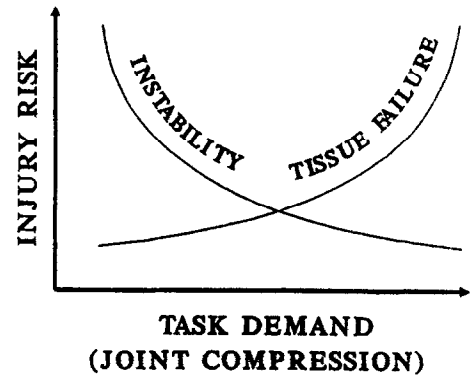

Fig. 8. While injury from high loading tasks is easier to rationalize, injury from low loading tasks appears to reduce spine stability and increases the possibility of injury from errors in motor control, and the resulting joint displacement and tissue overload.

CHANGES IN SPINE MECHANICS THROUGHOUT THE DAY

While several scientists have documented the diurnal change in spine length, Dolan *et al.* (1993) were one of the first to postulate an increased risk of injury early in the morning due to fully hydrated discs, higher bending stiffness and documented stresses associated with bending at this time of the day. In fact, it is critical in our modelling work when we examine subjects early in the morning that we recalibrate their torso stiffness throughout the test session as the spine becomes more flexible in bending which requires the disc stiffness and ligament rest length be reset to facilitate reasonable predictions of tissue load distribution. This knowledge may prove useful in the future for management, and those responsible for the design of work to reduce the risk of injury, to design jobs so that the most demanding bending loads on the low back are not conducted early in the morning (or shortly after rising from bed).

IS SITTING STRESSFUL FOR THE SPINE?

Epidemiological evidence presented by Videman *et al.* (1990) documented the increased risk of disc herniation

for those who perform sedentary jobs characterized by sitting. Known mechanical changes associated with the seated posture include the increase in intra-discal pressure when compared to standing postures (Andersson *et al.*, 1975), increases in posterior annulus strain (Pope *et al.*, 1977), creep in posterior passive tissues (McGill and Brown, 1992) which decreases anterior–posterior stiffness and increases shearing movement (Schultz *et al.*, 1979), and posterior migration of the mechanical fulcrum (Wilder *et al.*, 1988) which reduces the mechanical advantage of the extensor musculature (resulting in increased compressive loading). This has motivated occupational biomechanists to consider the duration of sitting as a risk factor when designing seated work in the interest of reducing the risk of injury. A recently proposed guideline has suggested a sitting limit of 50 min without a break, although this proposal will be tested and evaluated in the future.

THE SPINE HAS A MEMORY

There is a tendency among ergonomists to assess industrial tasks simply by examining the task at the time at which it is performed. There is evidence to suggest that certain activities modulate the subsequent mechanics of the spine such that those activities prior to performing a particular task may indeed warrant consideration. For example, for several years, it has been proposed that the nucleus within the annulus migrates anteriorly during spinal extension and posterior during flexion (MacKenzie, 1981). Due to viscous properties of the nuclear material, such repositioning is not immediate upon a postural change, but takes time. While this hypothesis was conjecture for a period of time, several experiments have been reported verifying a repositioning of nuclear material upon forced extension of the lumbar spine. Krag *et al.* (1987) demonstrated anterior movement, albeit quite minute, from an elaborate experiment that placed radio opaque markers in nucleus of cadaveric lumbar motion segments. Hydraulic theory would suggest lower bulging forces on the posterior annulus if the nuclear centroid moved anteriorly during extension. Furthermore, Adams and Hutton (1988) suggested that prolonged full flexion may cause the posterior ligaments to creep which may allow damaging flexion postures to go unchecked if lordosis is not controlled during subsequent lifts. The data of McGill and Brown (1992) showed that even after 2 min following 20 min of full flexion, subjects only regained half of their intervertebral joint stiffness, while even after 30 min of rest some residual joint laxity remained. This is of particular importance for those individuals whose work or movement patterns are characterized by cyclic bouts of full end range of motion postures followed by exertion. For example, it would appear to be unwise to perform demanding exertions following a prolonged period of fully flexed sitting or stooping.

SOME FINAL THOUGHTS ON CURRENT PRACTICE AND ISSUES FOR THE FUTURE

Some inconsistent current practice regarding low back injury continues despite some of the recent advances in understanding. The scientific community realizes that much injury is the result of cumulative trauma—although it may be marked by a culminating event. Current practices of injury reporting usually requires workers and medical personnel to identify the single cause of injury (i.e. a herniated disc as the individual lifted and twisted) which de-emphasizes investigation of the many variables involved in accumulating trauma. Overhaul of the current injury reporting system needs to be considered. Furthermore, there is a tendency to base judgement about the risk of injury on too much load magnitude—for example low back compression. It appears that too much of anything—too much compression, too many repetitions, sitting for too long or even staying in bed too long has negative effects. Failure to recognize these relationships has led some to de-emphasize investigation of spine biomechanics in analysing the cause and treatment of low back injury (which is a mistake in the opinion of this author).

Most often, judgement regarding a back injured person's fitness to return to work is based on their trunk range of motion. Perhaps it was rationalized that back injured people have a reduced range of motion and therefore to regain that range of motion is a desirable objective. However, investigation of spine mechanics demonstrates a variety of ills associated with moving the spine to the end range of motion (including increased risk of damage to the disc, ligaments and vertebral components), not to mention moving an already injured spine to the end range of motion. In fact, while there is epidemiological evidence to support the notion that some patients do better without any medical treatment at all (cf. Faas *et al.*, 1993), it is suspected that lack of knowledge about injury leads to inappropriate prescription of rehabilitation manoeuvres and injury exacerbation. It would appear that those responsible for rehabilitating the injured must continue to question their current approaches, particularly end range of motion activities for some types of injury.

In the occupational world, labour and management alike continue to seek easy and simple solutions to the low back injury problem. After investigating the mechanics of injury to the low back for several years, this author contends that a simple approach is destined to fail. Industrial low back injury is an extremely complex issue and will only be successfully addressed by those willing to combine the wisdom of several different approaches and to form an integrative approach that is scientifically justifiable.

Several issues will dominate our investigations in the future—particularly how low magnitude loading, applied over a sufficient length of time causes low back injuries. Specific examples include investigations of sitting, vibration exposure, load exposure with rest cycles, repeated lifting and other combined movements, and even the effects of not enough loading. Several groups are working towards occupational exposure guidelines that recognize concepts of dose and trauma accumulation, and, favourable tissue adaption, using combinations of the modelling approaches mentioned in this work together with finite element approaches, epidemiology and clinically based studies, etc. To assist these efforts the medical community must become better at diagnosing which

tissue is injured. Since different tissues respond to different treatment, and in fact may be further injured by some movements, specific diagnosis is mandatory for optimal rehabilitation. Finally, there are many loading modes that cause injury—other than compression, and effort is required to understand the consequences of such loads in order to formulate clever hypotheses for injury avoidance. Our community can look forward to the future with great enthusiasm, excitement and confidence that our contributions, while providing great personal joy, will reduce some suffering of others.

Acknowledgements—Although many colleagues have contributed to work reported in this manuscript, the author wishes to acknowledge a few special colleagues who have made significant contributions over the years: Professor Robert Norman, Dr Jacek Cholewicki, Dr James Potvin, Mr Jack Callaghan, Ms Vanessa Yingling, Mr Craig Axler and Daniel Juker, MD. Further, the financial support of the Natural Sciences and Engineering Research Council over the years is gratefully acknowledged.

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CITY OF RAYTOWN

Date: May 17, 2016 **Resolution No.: _____**
To: Municipal Committee
From: Kati Horner Gonzalez, Acting Director of Public Works

Department Head Approval: _____

Finance Director Approval: _____

City Administrator Approval: _____

Action Requested: Municipal Committee discussion of a contract for root control in the sanitary sewers with Duke's Root Control, Inc. in an amount not to exceed $30,000.00.

Recommendation: Staff recommends approval as submitted.

Analysis: Root control is performed annually in the Sanitary Sewer system. The amounts spent in past years has varied, but budget allows for $30,000 in 2016. Staff obtained a proposal from Duke's Root Control, Inc. for treating the sewer mains. The amount was not specified since the contract is a coop contract through the city of Lawrence Kansas. Staff proposes an amount of $30,000. Additional quotes were not required since the contract with Duke's Root Control, Inc. is part of a cooperative contract through the City of Lawrence Kansas. The cooperative contract is a linear foot contract with stipulated prices per linear foot for each size of sewer pipe. The project will not exceed the proposed amount. The funds are available from the sewer fund.

Alternatives: N/A

Budgetary Impact:

☐ Not Applicable
☒ Funds subject to appropriation of the Budget
☐ Non-Budgeted item with available funds through prioritization
☐ Non-Budgeted item with additional funds requested

Fund: Sewer Fund
Amount to Spend: $30,000.00

Additional Reports Attached: Copy of proposal from Duke's Root Control, Inc.

City of Lawrence
UTILITIES

DAVID L. CORLISS
CITY MANAGER

City Offices
PO Box 708 66044-0708
www.lawrenceks.org

6 East 6th St
785-832-3000
FAX 785-832-3405

CITY COMMISSION

MAYOR
ROBERT CHESTNUT

COMMISSIONERS
MIKE AMYX
ARON E. CROMWELL
LANCE M. JOHNSON
MICHAEL DEVER

NOTICE TO PROCEED

TO: **Duke's Root Control**

PROJECT: **2010 Sanitary Sewer Chemical Root Control – Bid #B09034**

The City of Lawrence Department of Utilities, represented by the undersigned, having executed the Contract dated **June 11, 2010,** hereby gives you written authorization to proceed with work on the above-referenced project on **July 1st, 2010.**

Please contact Bob Brower at (785)423-3392 to make arrangements to begin work.

Dated this **14th** day of **June, 2010.**

Mike Lawless
Assistant Utilities Director
City of Lawrence, Kansas

CONTRACT AGREEMENT

THIS AGREEMENT, made and entered into this 11th day of June, 2010 by and between the City of Lawrence, Kansas, Party of the First Part and hereinafter called the Owner, and Duke's Root Control, Inc. of Syracuse, NY, Party of the Second Part and hereinafter called the Contractor.

WITNESSETH:

THAT WHEREAS, the Owner has caused to be prepared, in accordance with law, specifications, plans, and other contract documents for the work herein described, and has approved and adopted said documents, and has caused to be published, in the manner and for the time required by law, an advertisement for and in connection with

2010 Sanitary Sewer Chemical Root Control - Bid #B09034

_____ in accordance with the terms of this Contract: and

WHEREAS, the said Contractor, in response to such advertisement, has submitted to the Owner, in the manner and at the time specified, a sealed proposal in accordance with the terms of said advertisement; and

WHEREAS, the Owner, in the manner prescribed by law, has publicly opened, examined, and canvassed the proposals submitted in response to the published invitation therefore, and as a result of such canvass has determined and declared the aforesaid Contractor to be the lowest and best bidder for the said work and has duly awarded to the said Contractor a contract therefore, for the sum or sums named in the Contractor's proposal. A copy thereof being attached to and made a part of this Contract.

NOW, THEREFORE, in consideration of the compensation to be paid to the Contractor and the mutual agreements herein contained, the Parties to these presents have agreed and hereby agree, the Owner for itself and its successors, and the Contractor for itself, himself, or themselves, or its, his or their successors and assigns, and its, his or their executors and administrators, as follows:

Article 1. It is hereby mutually agreed, that for and in consideration of the sum or sums to be paid the Contractor by the Owner as set forth in the Proposal, the said Contractor shall furnish all labor, equipment, accessories, and material (except material salvaged or otherwise furnished as specified) and shall perform all work necessary to construct and complete the improvements in a good, substantial, and workmanlike manner, ready for use, and in strict accordance with the contract drawings and specifications as approved and filed pursuant to law in the office of the legal representative of the Owner.

Article 2. It is hereby further agreed that, in consideration of the faithful performance of the work by the Contractor, the Owner shall pay the Contractor the sum or sums due him by reason of said faithful performance of the work, at the stated intervals and in the amounts certified by the Engineer, in accordance with the provisions of the General Conditions, and as set forth in the Proposal as accepted by the Owner.

Article 3. It is hereby further agreed that, at the completion of the work and its acceptance by the Owner, all sums due the Contractor, by reason of his faithful completion of the work taking into consideration additions to or deductions from the original contract or by reason of "Force Account" work authorized under the Contract in accordance with the provisions of the General Conditions, will be paid the Contractor by the Owner within thirty (30) days after said completion and acceptance.

Article 4. It is hereby further agreed that the words "he" or "him" wherever used herein as referring to the Contractor shall be deemed to refer to said Contractor, whether a corporation, partnership, or individual, and this contract and all covenants and agreements thereof shall be binding upon and for the benefit of the heirs, executors administrators, successors, and assigns of said Contractor.

Article5. It is hereby further agreed that any reference herein to the "contract" shall include all contract documents as specifically set out in the General Conditions and are hereby made a part of this agreement as fully as set out at length herein.

IN WITNESS WHEREOF, the First Party and the Second Party, respectively, have caused this agreement to be duly executed the day and year first herein written, in triplicate, all copies of which to all intents and purposes shall be considered as the original.

Owner, First Party

CITY OF LAWRENCE

By

City Manager
(office of positions of signer)

ATTEST:

City Clerk

CONTRACTOR, Second Party

By William J. Anderson

Vice President
(Office or position of signer)

City of Lawrence

BID # B09034, June 16, 2009

Bidder (Name of Firm) Duke's Root Control, Inc.

AUTHORIZES SIGNATURE _____ **DATE** 6/10/2009

TITLE OF PERSON SIGNING Vice President

ADDRESS 1020 Hiawatha Blvd. West, Syracuse, N.Y. 13204

PHONE NUMBER 315-472-4781

TWO COPIES OF THE COMPLETED BID SPECIFCIAATIONS ARE REQUIRED

TO BE COMPLETED BY VENDOR:
Vendor qualifies as a "local business entity" as defined in Chapter 1, Article 17 of the Code of the City of Lawrence (included in notice to bidders).

☐ YES ☑ NO

PROPSAL PRICE PAGE

(Submit with Bid)

Sewer line chemical root control, including all labor, materials, equipment and associated cost, shall be paid for at the unit price bid per linear foot of each size pipe. Unit prices are to be computed per linear foot manhole-to-manhole.

Pipe Size	2009 Unit Price Per Linear Foot	2010 Unit Price Per Linear Foot	2011 Unit Price Per Linear Foot	2012 Unit Price Per Linear Foot	2013 Unit Price Per Linear Foot	Estimated Footage Per year
8 inch	$1.29	$1.29	$1.29	$1.29	$1.29	77,519
10 inch	$1.76	$1.76	$1.76	$1.76	$1.76	
12 inch	$1.92	$1.92	$1.92	$1.92	$1.92	
15 inch	$2.73	$2.73	$2.73	$2.73	$2.73	
18 inch	$3.97	$3.97	$3.97	$3.97	$3.97	
24 inch	$6.35	$6.35	$6.35	$6.35	$6.35	

2009 Total Price $ 99,999.51

(2009 Total Price in words) NINETY NINE THOUSAND, NINE HUNDRED NINETY NINE dollars & fifty ONE cents

The City reserves the right to reject any or all bids. Bidders are cautioned not to attach any conditions, limitations, or provisions to the proposal as such conditions, limitations or provisions will render their bid informal and cause its rejection.

Submittals: Failure to enclose the following will render this bid non-responsive and result in the rejection of this bid.

✓ - Specimen Label with MSDS
✓ - Pollution Liability Insurance Certificate
✓ - Contractor's Qualification Page
✓ - Contractor's Reference Page
✓ - Contractor's Confined Space Entry Employee Certificates (2 minimum)

TWO COPIES OF THE COMPLETED BID SPECIFCIAATIONS ARE REQUIRED

Duke's

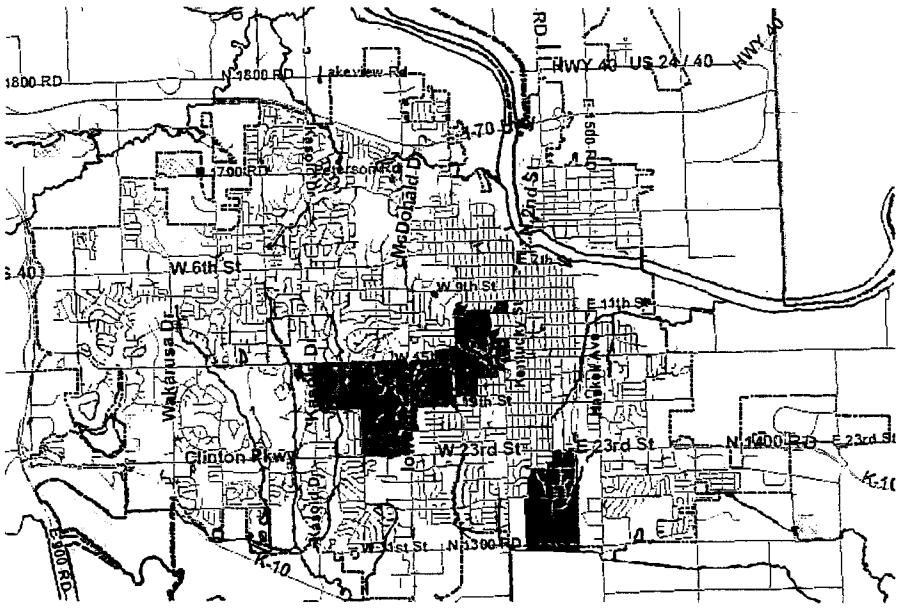
ORIGINAL

City of Lawrence

BID # B09034, June 16, 2009

2009
Wastewater Collection System
Chemical Root Control
Project Specifications

City of Lawrence Kansas
Department of Utilities



SCOPE OF WORK:

The proposed root control project consists of, but not limited to, the chemical root control application of approximately 77,519 linear feet of 8 inch diameter and larger sewer pipe.

INTENT:

It is the intent of this specification to provide for the contract services for chemical root treatment application to 77,519 feet of 8 inch diameter and larger, sanitary sewer main owned by the City of Lawrence Kansas. The contract will be for a 1-Year period and may be extended additional 1-Year periods up to a total of 5-Years.

The City has evaluated different types of chemical root control applications and has determined that the product specified is best suited for the City's needs in safety, quality and standards of performance. This specification is not intended to be interpreted as restrictive, but rather as a measure of the safety, quality and performance which all chemical root treatment application bids will be compared.

In comparing proposals, consideration will not be confined to price only. The successful bidder will be one whose product is judged to best serve the interests of the City when price, safety, quality and delivery are considered. The City of Lawrence reserves the right to reject any or all bids or any part thereof, and to waive any minor technicalities. A contract will be awarded to the bidder submitting the lowest responsible bid meeting the requirements of this specification.

1. EQUIVALENT PRODUCT

The purpose of the project specified herein is to apply chemical root control agent to sanitary sewers, in order to kill root growth present in lines and to inhibit the root growth present in the pipes and to inhibit re-growth, without permanently damaging the vegetation producing roots. The chemical agent shall be Razorooter II ™ or equivalent products approved by the City in writing **prior to the bid date.**

Decisions of equivalency will be at the sole interpretation of the City of Lawrence. A blanket statement that root control agent proposed will meet all requirements will not be sufficient to establish equivalence. Original manufacturer's brochures of the proposed root control agent are to be submitted with the proposal. All modifications made to root control agent described in the manufacturer's brochures must be certified by the manufacturer to have been in prior successful use for more than two years (including the name of user's) and submitted with the bid, or the bid will be deemed "non-responsive" and rejected without further review. Bidder must be prepared to demonstrate a root control agent similar to the one proposed, if requested.

2. GENERAL

The specification herein states the minimum requirements of the City. All bids must be regular in every respect. Unauthorized conditions, limitations, or provisions shall be cause for rejection. The City of Lawrence will consider as "irregular" or "non-responsive" and reject any bid document not prepared and submitted in accordance with the bid document and specification, or any bid lacking sufficient technical literature to enable the City to make a reasonable determination of compliance to the specification.

It shall be the bidder's responsibility to carefully examine each item of the specification. Failure to offer a completed bid will cause the proposal to be rejected without review as "non-responsive". Deceit in responding to the specification will be cause for rejection.

3. CONTRACTOR RESPONIBILITIES

The Contractor's attention is drawn to the following terms, conditions and responsibilities:

A. Bidders must be licensed with the Kansas Department of Agriculture **prior to bid date.** All bidders must have a minimum level of pesticide application experience, (see Section 10), and employ a State Certified pesticide applicator on the job site at all times.
B. *Contractor* shall provide Pollution Liability Insurance; in addition to all other insurance specified herein (see Section 11).
C. The *Contractor* shall provide a money-back guarantee on all work specified herein as set forth below (see Section 4).
D. The *Contractor* is responsible for all property damage and for all cleanup and restoration associated with any chemical spill. (See Section 7). The Contractor is not responsible for any damages caused by sewer stoppages.
E. Where work is located in high-traffic areas, The *Contractor* shall place proper traffic warning devices to protect the specific job site and to prevent accidents or personal injury to the public as per the latest revised MUTCD.
F. The *Contractor* shall use a reduced-pressure-zone backflow device whenever accessing fresh water for mixing chemicals.
G. The *Contractor* shall return every 4-8 months throughout the life of the guarantee, in order to evaluate the success of the project, and to arrange any free guarantee work that may arise.
H. The *Contractor* shall comply with all Federal, State and Local Laws, with special attention to those that pertain to the handling, transportation, and use of any hazardous materials, and disposal of all pesticide containers.

4. GUARANTEE

For each sewer section (manhole-to-manhole) that is treated under the Contract, the *Contractor* shall guarantee the work as follows. The *Contractor* shall at his own expense, **re-treat a sewer section**, in the event that:

1. live roots are found in the section within six months after the application: or
2. the section plugs up and floods due to root obstructions within a two year period, beginning the date of treatment, and ending two years after the date of treatment. Re-treatments, performed at no charge in honor of the guarantee, do not extend the expiration date of the guarantee.

The guarantee applies to sewer stoppages caused by tree roots. It does not apply to stoppages caused by grease or other foreign matter; flat, collapsed or deformed pipe; or flooding caused by a surcharged or plugged sewer section downstream from a guaranteed sewer section. The decision of the City as to the cause of the stoppage is binding.

5. COMPOSITION OF THE CHEMICAL ROOT CONTROL MATERIAL

The chemical root control agent shall be Razorooter II ™ or equivalent product that is approved by the City in writing **prior to the bid opening**. The chemical root control agent shall be registered with the EPA and the Kansas Department of Agriculture, **prior to bid opening**, and shall be labeled for use in sewers to control tree roots. The chemical root control agent shall contain an active ingredient for controlling sewer roots and deterring their re-growth. There shall also be a surfactant system to deliver the active ingredient (herbicide) to target root tissue.

A. **Active Ingredient**

1. Shall be Category "E" compound, the most favorable rating attainable on the U.S. EPA's chronic exposure toxicological rating scale.
2. Shall **not** be considered a carcinogen, teratogen, mutagen, or oncogene, based on laboratory testing.
3. Shall carry a "signal word" assigned by the U.S. EPA of either "Warning" or "Caution", on the product label.
   Pesticides carrying the signal word "DANGER" shall not be accepted.
4. Shall be non-volatile in order to minimize exposure to workers and other individuals by inhalation.
5. Shall not be readily absorbed through the skin.
6. Products containing the active ingredient(s) metam-sodium or copper sulfate are not allowed.

B. **Surfactant System**

1. Shall produce a dense, small bubble, clinging foam, which sustains its shape for a minimum of one hour.
2. Shall enhance the penetration of herbicide into root masses.
3. Shall contain a Alkylpolglucose (formulations of vegetable oil and carbohydrate from agriculture products).
4. Surfactants designed to foam chemically, upon contact with water, shall not be accepted (see Section 6 below).

6. MANNER OF APPLICATION

All work shall be performed according to label instructions and in accordance with the best recommended practice for conditions present in the line under treatment. All applications shall be done by foaming or other methods as provided on the product label.

The application of material shall be performed in such a way as to contact roots within the primary main line sewer to be treated. Effort will also be made to penetrate secondary lateral sewers in order to contact roots residing in the "wye" connections. The foam shall be generated through the use of air injection equipment, and the foam shall be pumped into the sewer under pressure-as-foam. Foam quality shall be sufficient to penetrate "wye' connections, effectively treat larger diameter pipe and to enhance treatment effectiveness overall. Therefore, applications of chemicals designed to generate foam "chemically" on contact with water shall not be accepted.

Hydraulic sewer cleaning machines will reduce treatment effectiveness by damaging root growths and inhibiting their uptake of chemical. Hydraulic sewer cleaning machines shall not be used prior to, or during the treatment process.

7. PROPERTY DAMAGES CAUSED BY THE CONTRACTOR

Should the *Contractor* or his employees cause any damage to public or property, the *Contractor* will be required to make repairs immediately. The City may, however, elect to make repairs or replacements of damaged property and deduct the cost of such from moneys due or to become due the *Contractor* under this contract with the City. The Contractor shall not be responsible for any damages caused by sewer stoppages after application is completed.

8. PROTECTION OF WASTEWATER TREATMENT PLANT

The *Contractor* shall take all steps necessary and appropriate to prevent adverse effects on wastewater treatment plant processes during the application process.

Notwithstanding the requirement that the active ingredient shall not adversely effect wastewater processes, in the event that a wastewater treatment plant experiences any reduction in operating efficiency during the execution of the contract, the *Contractor* shall immediately suspend all applications, at the direction of the City. The *Contractor* shall continue operations only after problems at the wastewater treatment plant have been corrected, satisfactory to the Wastewater Treatment plant Manager.

The *Contractor* shall have in his possession, and make available to the City on request, a recent study from an accredited research facility documenting the effects of the product on wastewater treatment plant facilities. At a minimum, this study shall address the toxicity of the product on wastewater treatment plant biota, including nitrifiers and denitrifiers, and toxicity of the product on treatment effluent, and the environmental fate of the product. This requirement is mandatory.

9. POLLUTION AND LIABILITY INSURANCE

The Pollution Liability Insurance described herein is **in addition to** all other insurance required of the *Contractor* by the City, including any insurance described in the general conditions, any insurance required by law, or any insurance requested by the City.

At the time of the bid opening, the *Contractor* shall submit written evidence that he/she has obtained pollution liability coverage. This coverage shall protect the *Contractor*, the City, and the City's officers, agents, and employees from claims for damages for bodily or personal injury, sickness or disease, including death, and from claims for damages to property and/or the environment, which may arise directly out of the use of chemicals and/or pollution. The minimum amount of such insurance shall be $5,000,000 total loss. An "A" rated insurance company shall provide the *Contractor's* pollution liability insurance.

In addition, the *Contractor's* commercial general liability limits must not be less than $10,000,000, total occurrence limit, and include pesticide or herbicide applicator coverage.

10. COMPLIANCE WITH LAWS

The *Contractor* is directed to ensure compliance with all Federal, State and Local ordinances pertaining to the type of work specified herein. Particular attention shall be paid to those laws and ordinances of relating to transportation of material (DOT), the application of sewer root control herbicides (US EPA), and traffic safety regulations. The *Contractor's* Federal DOT number and material EPA registration number must be submitted with the bid.

11. QUALIFICATIONS

The *Contractor* shall demonstrate a minimum of ten (10) years direct experience in applying chemical sewer root control agents. The *Contractor* must have performed at least 20 other jobs similar in size and scope to the work specified herein, and have treated in excess of 750,000 linear feet of sanitary sewer. Any work performed by subcontractors for the *Contractor* will not be considered.

The *Contractor* shall be licensed as a pesticide application business with the Kansas Department of Agriculture **prior to the bid opening**. *Contractors* who do not meet the experience and other qualifications specified herein shall not be considered for award of the contract. **Each bidder is required to submit with his bid the contractor qualification form attached to these specifications.** Additional references, up to ten, may be requested by the City.

All work shall be performed by Certified Pesticide Applicators licensed with the Kansas Department of Agriculture. Certified Pesticide Applicators shall have a minimum three years experience in performing the type of work specified, and shall each have personally performed a minimum of 500,000 linear feet of treatments as a Certified Pesticide Applicator and/or under the direct supervision of a Certified Pesticide Applicator. A minimum of three Certified Pesticide Applicators that are registered with the Kansas Department of Agriculture, prior to the bid is required. License numbers of these three applicators shall be submitted with the bid.

12. ASSISTANCE PROVIDED BY THE OWNER

A. A representative of the City will accompany the *Contractor's* crew, and/or sewer system drawings will be provided showing the exact locations of pipes to be treated.
B. The City shall provide for entering of private lands, public lands and right-of-ways.
C. The City shall provide a source of fresh water at a location or locations to be designated by the City.
D. The City shall locate and uncover hidden or buried manholes, and restore street surfaces, easements, etc.

13. CONTRACT PERIOD

The initial term of the contract shall be for the period of one year. The contract may be extended for additional one year period up to a total of five years, with mutual consent of the City and the *Contractor*. Price changes for succeeding years shall be adjusted in accordance with the consumer price index for the City's locale.

14. PAYMENT

Payment to the *Contractor* shall be made only after all work specified by the contract has been completed to the City's satisfaction, and all reports and submittals requested by the specifications or the City have been received by the City.

15. SUBSTITUTES AND PROVEN EQUIVALENTS

Use of any substitute or equivalent procedures, methods, or materials must be approved by the City in writing **prior to the bid date.**

Should the Contractor wish to use any brand of material other than as specified herein, he shall submit to the City for review, complete descriptive literature naming the proposed substitution and manufacturer. Any equivalent material or methods shall comply with the requirements set forth above (see Sections 4 COMPOSITION OF ROOT-CONTROL MATERIAL, and Section 5 MANNER OF APPLICATION).

CONTRACTOR'S QUALIFICATIONS PAGE
(Submit with Bid)

Failure to complete this page in full, and to provide valid, existing licenses and insurance, as required, will render this non-responsive and result in the rejection of this bid.

Contractor Name: Duke's Root Control, Inc.

Contractor's Kansas Pesticide Business License #: 5177

Contractor Federal Department of transportation #: 1559146

Name of Proposed Chemical Root Control Agent: RazoRooter II

USEPA Root Control Agent Registration #: 64898-8

Kansas Root Control Product Registration #: 1994

Does the Contractor have Pollution Liability Insurance as specified? yes

Contractor's Pollution Control Liability Insurance Carrier: Greenwich Insurance Comp.

What is the AM Best rating of your Pollution Insurance carrier? A

Does the Contractor have a minimum 10 years of experience in the type of work specified, treated in excess of 750,000 linear feet of root treatments, and completed at least 20 other jobs similar in size and scope, which the City can verify? yes

Are two (2) Copies of Contractor employee Certificates of Completion in confined space entry training, per federal code 29 CFR 1910.146 attached? yes

Does the Contractor have a recent study documenting the effects of the product on wastewater treatment plants? yes

Contractor's Kansas Certified Pesticide Applicators
(List 3 minimum)

1. Name: Richard Yazel Certification #: 18146

2. Name: Gary Roberts Certification #: 13266

3. Name: Charles W. Morse Certification #: 17321

BIDDER'S REFERENCE PAGE
(Submit with Bid)

The Contractor shall submit municipal references for chemical sewer root control, which the City can verify. Each reference shall be for work actually performed by the Bidder. All references shall pertain to actual root control work performed by the Bidder (sub-contractor references are not applicable). Reference work shall have been performed with the manner of application specified herein. Submit sufficient references on a project by project basis; so that the completed work in total for said municipalities exceeds the specified limit of 500,000 lineal feet of root treatments (minimum of three).

ALL REFERENCES WILL BE TREATED AS THE CONTRACTOR'S CONFIDENTIAL BUSINESS INFORMATION. Previous work for the City may be used as references. Complete each item for all 3 references.

Owner/Agency	City of Olathe
Address:	1415 South Robinson Drive
Address:	
City, State, Zip	Olathe, KS 66051
Contact:	Randy mather
Phone:	913-971-9054

Owner/Agency	City of Lawrence
Address:	P.O. Box 708
Address:	
City, State, Zip	Lawrence, KS 66044
Contact:	Bob Brower
Phone:	785-832-7821

Owner/Agency	City of Topeka
Address:	1115 N.E. Poplar, "U" Bldg.
Address:	
City, State, Zip	Topeka, KS 66616
Contact:	Dennis Dunbar
Phone:	785-295-3851 Ext. 538

TOTAL FOOTAGE TREATED 1,188,178 Ft.

Only Contractor's experienced in this type of work will be considered. Failure to provide sufficient verifiable references whose total work exceeds 750,000 linear feet will result in rejection of this bid.

DUKE'S
ROOT CONTROL, INC.
The Full-Service Root Control Experts

1020 Hiawatha Blvd., West
Syracuse, NY 13204-1131
1-800-44-ROOTS
(315) 472-4781
Fax (315) 475-4203

January 20, 2015

Bob Brower
W.W. Field Operations Manager
City of Lawrence
P.O. Box 708
Lawrence, KS 66044

RE: Sewer Line Chemical Root Control Project
Contract #B09034

Dear Mr. Brower:

This letter is to formally state that Duke's Root Control, Inc. agrees to extend the above referenced contract under the same terms, conditions and pricing of the original contract thru June 30, 2016.

Please let me know if you require any further information. We look forward to being of service.

Sincerely,

William J. Anderson
Vice President

CITY OF RAYTOWN
Request for Committee Action

Date: May 17, 2016
To: Municipal Committee
From: Kati Horner Gonzalez, Acting Director of Public Works

Action Requested: Municipal Committee discussion of repairs for the EMS building roof in the amount of $12,600.

Overview: The EMS building, located at 10020 E 66th Terrace, was built in 1999. In 2006, a leak was caulked, however no other work has been done for the roof since that time. Over the past two years, the building has experienced the buildup of ice on the roof, leading to leakage into the building.

Staff has requested the submittal of quotes from six roofing companies, three responded. Staff has determined that the quote provided by Precision Roofing will provide the best product. The repairs included are the cleaning of the roof and the application of a coating which will seal existing leaks and protect the roof. The coating is projected to last ten years and has a five-year warranty.

This project was scheduled to be complete during fiscal year 2017, however funds are available for this project now due to the copier bids coming in low.

Alternatives:
Budgetary Impact:

☐ Not Applicable
☐ Budgeted item with available funds
☒ Non-Budgeted item with available funds through prioritization
☐ Non-Budgeted item with additional funds requested

Copier Purchase	
Fund:	Capital Fund
Amount to Spend:	$14,119.23

Additional Reports Attached: Bid Documents, Pictures of roof

PRECISION ROOFING
A SUBSIDIARY OF PRECISION DIVISIONS, INC.

Proposal

Prepared for:
Tony Mesa

10000 E 59th Street
Raytown, MO 64133

Prepared by:
Stephanie Singer,
Precision Roofing
Office: (816) 254-7100
Mobile: (816) 718-7357
Email: ssinger@roofingkc.com

Precision Roofing
11903 E. Old Lone Jack Lee Summit Road
Lees Summit, MO 64133
Office (816) 365-0515
Cell: (816) 718-7357
Fax: (816) 254-7337
Email: ssinger@roofingkc.com
www.RoofingKC.com

Proposal

10020 E. 66th Terrace
Raytown, MO 64133

Tony Mesa,

We appreciate the opportunity to present this proposal. Precision Roofing has been installing top-quality roofing systems for more than 25 years, including new and replacement roofs, service work and preventative maintenance programs for both commercial and residential customers.

Precision Roofing proposes to furnish labor and materials to complete the following work on the above-referenced Project as follows:

Retro-Fit Metal Roof 20 year System Prevailing wage SS 5.3.16

-Sweep roof deck clean off all debris
-Install Flute Fill 1.5"X9" EPS (expanded polystyrene) flute fill between metal ribs to bring roof deck level to top of ribs
-Mechanically attach on layer of 1/2" Wood Fiber board over flute fill
-Mechanically attach one layer of .060 mil, GAF TPO membrane per manufacturer's specifications
-Install new TPO flashings around plumbing vent pips and heat stacks per manufactures specifications
-Install new, 24ga pre-finished metal drip edge at eaves
-Install new, custom gravel stop with cleat

Price: $32,300

Repair Metal Roof 5 year warranty Prevailing wage SS 5.3.16

Section A. Roof above offices
-Power Wash
-1 coat @ 1.5 Gallons per SQ (1SQ=100sqft)

Price: $6,300

Section B. Roof above EMS vehicles
-Power Wash
-1 coat @ 1.5 Gallons per SQ (1SQ=100sqft)

Price: $6,300

Payment Terms: 50% of contract is to be paid upon delivery of materials. The balance is to be paid IN FULL upon completion of work. If problems or defects should arise after completion, Company and/or manufacturer's warranty applies. IN THE EVENT OF PAYMENT DEFAULT, FINANCE CHARGES SHALL BE ASSESSED ON THE OVERDUE BALANCE AT A RATE OF ONE AND ONE-HALF PERCENT (1 ½%) PER MONTH (18% PER ANNUM) FROM THE DUE DATE. PURCHASER SHALL BE LIABLE FOR ANY AND ALL COSTS INCURRED BY COMPANY TO COLLECT AMOUNT IN DEFAULT UNDER THIS CONTRACT INCLUDING, BUT NOT LIMITED TO COLLECTION AND/OR ATTORNEY FEES, COURT COSTS, ETC. ALSO, ALL COMPNAY AND/OR MANUFACTURER'S WARRANTIES ARE NULL AND VOID.

Stephanie Singer
Precision Roofing

The undersigned Building Owner or Authorized Representative accepts this proposal as of:

Date

Contracting Party

By

Printed Name & Title

This proposal is subject to the attached "Precision Roofing Terms & Conditions"

NOTICE TO MISSOURI OWNERS: FAILURE OF THIS CONTRACTOR TO PAY THOSE SUPPLYING MATERIAL OR SERVICES TO COMPLETE THIS CONTRACT CAN RESULT IN THE FILING OF A MECHANIC'S LIEN ON THE PROPERTY WHICH IS THE SUBJECT OF THIS CONTRACT PURSUANT TO CHAPTER 429 RSMO. TO AVOID THIS RESULT YOU MAY ASK THIS CONTRACTOR FOR "LIEN WAIVERS" FROM ALL PERSONS SUPPLYING MATERIAL OR SERVICES FOR THE WORK DESCRIBED IN THIS CONTRACT. FAILURE TO SECURE LIEN WAIVERS MAY RESULT IN YOUR PAYING FOR LABOR AND MATERIAL TWICE.

This contract is between Precision Divisions, Inc. d/b/a Precision Roofing, herein referred to as "Company," and the purchaser(s) named herein and hereafter referred to as "Purchaser." This contract is subject to all appropriate laws, regulations and ordinances of the states of Missouri and Kansas, and is also subject to the following terms and conditions:

1.This proposal may be withdrawn by the Company if not accepted by the Purchaser within thirty (30) days.

2.Purchaser is responsible for protecting or removing personal property from the attic prior to the start of the job, and for moving objects away from the perimeter of the building.

3.The Company shall not be liable for pre-existing conditions of roof deck, i.e., sags, dips, humps, waves, etc., in pre-existing material, i.e., plywood, wafer board, solid wood sheeting, rafters, braces and supports, etc., due to warped, rotted, bent, cracked, broken, shifted, settled, exposed, poorly-installed, thin, or weak material and structure. Replacement of deteriorated decking, fascia boards, roof jacks, ventilators, flashing or other materials, unless otherwise stated elsewhere in this contract, is not included and will be charged on a time-and-material basis.

4.The Company will not be responsible for damage to existing roof solar panels during work. Purchaser agrees to direct Purchaser's solar panel vendor or contractor to take appropriate action to protect solar panels if necessary.

5.Payment is to be made IN FULL upon completion of work. If problems or defects should arise after completion, Company and/or manufacturer's warranty applies. IN THE EVENT OF PAYMENT DEFAULT, FINANCE CHARGES SHALL BE ASSESSED ON THE OVERDUE BALANCE AT A RATE OF ONE AND ONE-HALF PERCENT (1½%) PER MONTH (18% PER ANNUM) FROM THE DUE DATE. PURCHASER SHALL BE LIABLE FOR ANY AND ALL COSTS INCURRED BY COMPANY TO COLLECT AMOUNT IN DEFAULT UNDER THIS CONTRACT INCLUDING, BUT NOT LIMITED TO, COLLECTION AND/OR ATTORNEY FEES, COURT COSTS, ETC.

6.The Company shall have no responsibility for damage from rain, fire, tornado, windstorm or other perils as are normally contemplated to be covered by homeowner's insurance or builder's risk insurance, unless a specified written agreement be made therefor prior to commencement of the work. Throughout duration of the work, the Purchaser's homeowner's or builder's risk insurance will be responsible for any interior damage unless such damage is due to Company's negligence.

7.Company is covered by worker's compensation and general liability insurance. The contract price does not include bond or insurance premiums or costs beyond normal liability and worker's compensation insurance. If Purchaser wishes Company to obtain bond or builder's risk insurance, such additional premiums or costs shall be added to the amount of the contract.

8.The Company shall not be liable for failure of performance due to labor controversies, strikes, fires, weather, inability to obtain materials from usual sources, or any other circumstances beyond the control of the Company.

9.THIS CONTRACT CANNOT BE CANCELED EXCEPT BY THE MUTUAL WRITTEN AGREEMENT OF THE PARTIES. If Purchaser cancels this contract later than 3 days following execution, Purchaser shall pay to the Company twenty-five percent (25%) of contract price as liquidated damages, not as a penalty, and Company agrees to accept such as a reasonable and just compensation for said cancellation.

10.If material must be reordered or restocked because of a change by the Purchaser, Purchaser agrees to pay a re-stocking fee equal to fifteen percent (15%) of the contract price.

11.This contract or warranty shall not be assigned except by written permission of the Company.

12.If any provision of this contract should be held invalid or unenforceable, the validity and enforceability of the remaining provisions of this contract shall not be affected thereby.

13.Purchaser warrants that the materials requested to be used under terms of this contract are appropriate and in compliance with all deed restrictions, commercial and/or homeowners' association covenants, conditions and restrictions. Purchaser assumes all risks of failure of such compliance.

14.THIS PAGE AND THE REVERSE SIDE SHALL COMPRISE THE ENTIRE CONTRACT. ANY ORAL REPRESENTATIONS, STATEMENTS OR ANY OTHER COMMUNICATIONS BETWEEN COMPANY AND PURCHASER PRIOR TO THIS CONTRACT ARE NOT PART OF THIS CONTRACT AND ARE NOT TO BE RELIED UPON BY EITHER PARTY.

15.Company warrants its roofing system to be free from leaks for the duration specified on the reverse side. Company assumes liability for the repair of any defect in workmanship or installation causing leakage. Roofing material is warranted by the manufacturer under a separate warranty which is issued to Purchaser. Company shall have no liability for any interior or exterior damage to Purchaser's building. Company's liability to Purchaser under this warranty in no case shall be greater than the contract price. In no event shall Company be liable for lost profits or any incidental, special or consequential damages. These limitations apply whether liability is based on contract, negligence or otherwise. When this warranty expires, all liability under the warranty ends. THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, PAST OR PRESENT, EXPRESS OR IMPLIED, STATUTORY OR COMMON LAW, AND COMPANY SPECIFICALLY DISCLAIMS ANY OTHER WARRANTY, GUARANTY OR REPRESENTATION. THERE IS NO WARRANTY OF MERCHANTABILITY, MARKETABILITY, PROFITABILITY OR FITNESS FOR PURCHASER'S INTENDED USE OR ANY OTHER PARTICULAR PURPOSES. This warranty does not apply and is void if the roof has been altered without Company's written authorization or otherwise is damaged, unless Purchaser can show that the alterations were not a cause of the defect. Company shall not be liable for Purchaser variances from specifications that are made at Purchaser's request to the on-site roofing crew.

16.Owners: Purchaser warrants that he/she/they are owner(s) of the project and property, or are agents of the owners authorized to bind the owners.

17.Any dispute arising under or related in any way to this contract shall be subject to the exclusive jurisdiction of the courts located in Jackson County, Missouri.

Glossary of terms used to describe condition of existing roof.

Flashing Defects Cap

Flashing is a building device used to prevent water from penetrating the exterior surface of a building element or material, or to intercept and lead water out of it. Flashing can be considered a continuation of the roofing membrane to protect and weatherproof any element of the building or roof deck that departs from the roof deck level or incline. Cap flashing is the sheet metal coping for the top of a higher wall, such as a parapet, or the cover over a detail, such as an expansion joint to prevent water seepage behind the base flashing.

Ponding

The NRCA has classified "undesirable" ponding water as standing for more than 48 hours, although ponding can pose a threat in even shorter time spans. A 1-inch deep pond weighs 5.2lbs per square foot and many structures cannot handle this extra load. Ponding water can be traced to any of several factors. First, a roof may pond water as a result of poor housekeeping on the roof which contributes to clogged drains, gutters and downspouts. The build-up of rooftop debris or displaced gravel ballast frequently blocks water flow and creates ponds. Second, the building's roof top drainage system may not have been designed properly. Finally, ponds form as a result of such common conditions as building settlement and deck deflection. Because ponds occur in low areas of a roof, a pond becomes a repository for debris, sediment, and chemical emissions. Ponding encourages microorganism and bacterial degradation, roof deflection, magnified ultraviolet exposure and ultimate premature failure of the roof system. If the roof membrane in a ponded area sustains damage, all of this water may drain into the roof system and into the building. The additional weight load may pose a threat to the structural integrity of the building, with a very real possibility of collapse of the roof in extreme cases.

Previous Repairs

Repairs to the roof membrane were observed indicating previous roof problems.

Vegetation

A rooftop environment that is rich with moisture and airborne dirt and particulates can be the breeding ground for seeds. These seeds can grow into vegetation with root structures that can penetrate and rupture the strongest of roof membranes, resulting in leakage into the roof system and the building's interior.

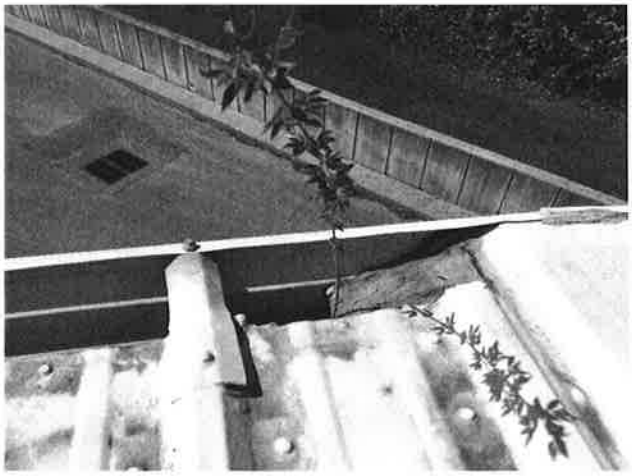
Roof Overview

Roof Overview

Roof Overview

Flashing Defects Cap & Previous Repairs

Ponding



Vegetation

Flashing Defects Cap & Previous Repairs

Flashing Defects Cap & Previous Repairs

Flashing Defects Cap & Previous Repairs

Ponding

Ponding

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